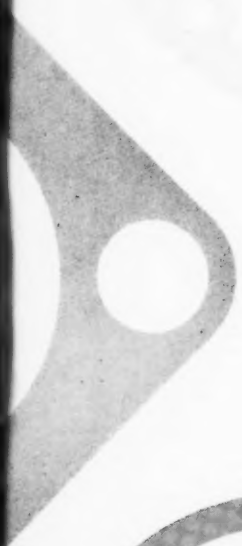
PETROLEUM REFINING • PETROCHEMICAL MANUFACTURING • GAS LIQUID RECOVERY

MARCH, 1957

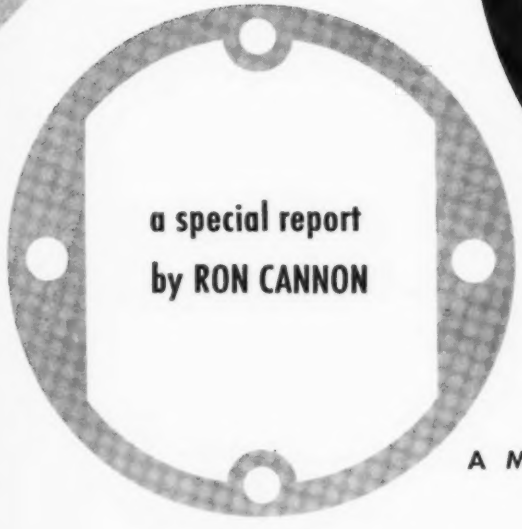
Petroleum Processing



how to choose and use today's GASKETS in today's equipment

p. 95

a special report by RON CANNON

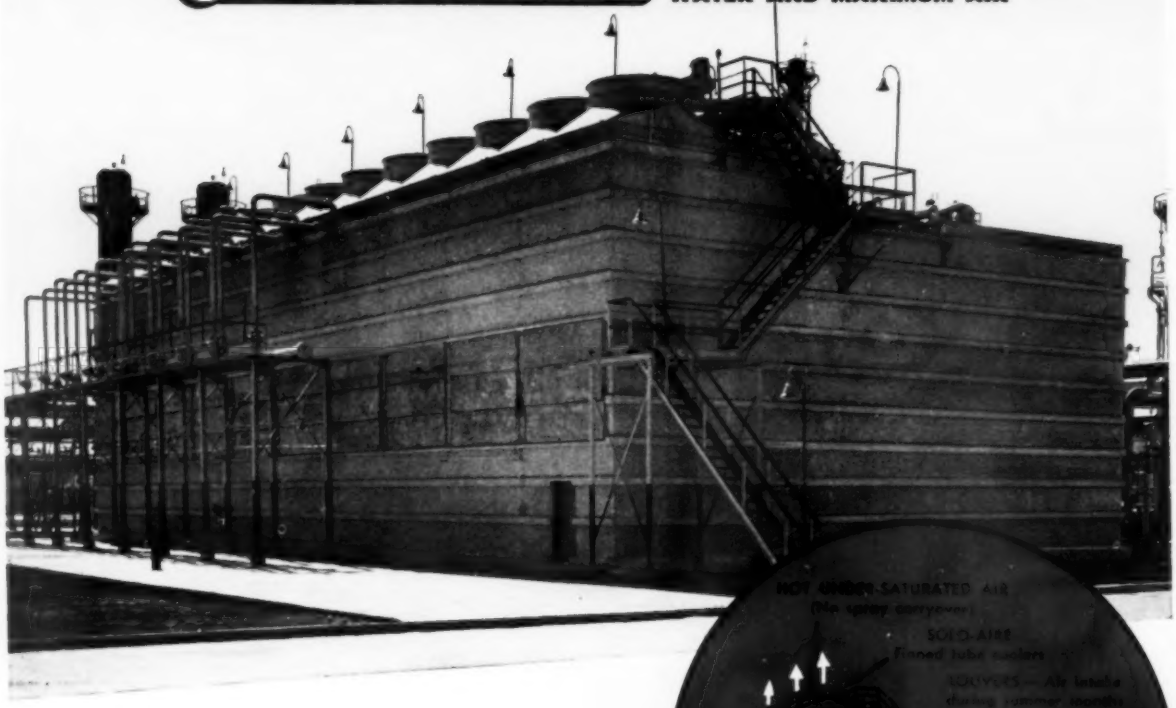


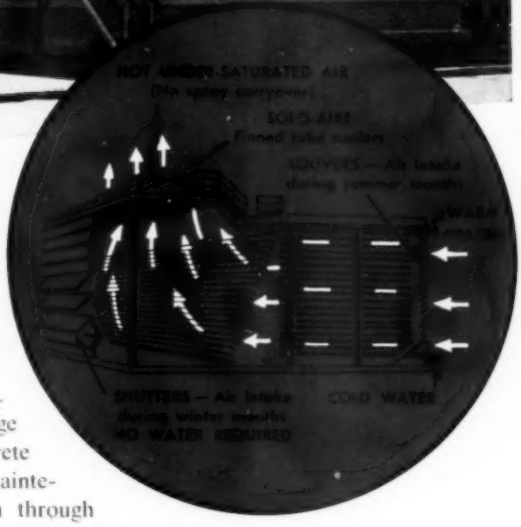
A McGRAW-HILL PUBLICATION PRICE 35 CENTS

FUEL INJECTION and six changes it can bring to gasoline . . . . . p. 59
GOING INTO RADIATION? Nine important questions and answers . . p. 68
GOOD MAINTENANCE DOESN'T "JUST HAPPEN" . . . . . p. 75

HUDSON Combin-aire

LOW TEMPERATURE COOLING USING COMBINATION OF MINIMUM WATER AND MAXIMUM AIR





Where quantity or quality of water is low, and ambient air temperatures too high to permit direct cooling with air, process plant designers find the modern solution in Combin-aire. In addition to large savings through minimizing water consumption and eliminating water treatment, Combin-aires incorporate many other advantages.

The Combin-aire pictured above, installed in a large gas processing plant in northern Mexico, is of concrete construction, eliminating fire hazard and minimizing maintenance. As shown in the cut-away drawing, air is drawn through cooled water by fans located on top of the structure. The air, precooled and washed free of solids by the water, flows across the finned tube coolers, and leaves the top of the Combin-aire at elevated temperature under-saturated with water vapor. Mist carryover, condensation from effluent air, and air recirculation are thus eliminated. Combin-aires are installed adjacent to process equipment, minimizing piping and concentrating operating area.

In winter, air flows directly to the Solo-aire finned coolers, water circulation being unnecessary. Where water is required for shell and tube units or atmospheric sections, such water may also be cooled in the Combin-aire unit, eliminating the conventional cooling tower.

In addition to Combin-aire units, Hudson manufactures water cooling towers, air-cooled and water-cooled coolers and condensers, and is experienced in plant layout, piping, and water treatment. We shall be glad to assist prospective plant owners in making overall comparisons of first costs and operating costs for complete cooling systems using various combinations of equipment.

HUDSON

ENGINEERING CORPORATION

FAIRVIEW STATION • HOUSTON, TEXAS

405 Lexington Ave., New York 17, N. Y. • 2500 W. Sixth St., Los Angeles 57, Calif. • Corrientes 1115, Buenos Aires, Argentina

Let Harshaw Catalysts do a GIANT'S work for you

Harshaw Catalysts do a giant's work and Harshaw produces catalysts in giant quantities—carloads every week. A letter or phone call will put our 20 years' experience and acres of production and research facilities to work for you.

PREFORMED CATALYSTS
to fit special process requirements

Hydroforming
Cyclization
Oxidation
Dehydrogenation
Dehydration
Desulphurization
Alkylation
Isomerization
Hydrogenation

CATALYTIC CHEMICALS SUPPLIED BY HARSHAW

Aluminum Nitrate — Cobalt Nitrate
Copper Nitrate — Manganese Nitrate Solution
Metallic Soaps (Cobalt, Manganese)
Nickel Carbonate — Nickel Formate — Nickel Nitrate
Nickel Sulfate — Sodium Methoxide — Zinc Nitrate

Our experienced technical staff will assist you in developing the best and most economical catalyst. If you have a catalytic process in the development or production stage, a discussion with us may prove beneficial.

Write for Free Book

THE HARSHAW CHEMICAL CO.
Chicago • Cincinnati • Cleveland • Detroit • Hastings-On-Hudson
Houston • Los Angeles • Philadelphia • Pittsburgh

TABLETS

SPHERES

EXTRUSIONS

GRANULES

POWDERS

FLAKES

(To obtain more data on advertised products see page 170)

Reader's Guide

What's New in Petroleum

PETROLEUM REFINING I | PETROCHEMICAL MANUFACTURING II | GAS LIQUIDS RECOVERY III | RESEARCH & DEVELOPMENT 1 | DESIGN & ENGINEERING 2 | PLANT OPERATION 3 | MAINTENANCE & CONSTRUCTION 4 | MANAGEMENT & PERSONNEL 5

An *EXTRA* this month:

Special 16-page

PETROLEUM PROCESSING report

how to choose and use today's GASKETS in today's equipment

- What a gasket is and how it works
- Five types of gasketed joints
- Three forces acting on gaskets
- Two factors in choice materials
- What materials are available for gaskets
- A 14-point gasket selection check list
- What you need to know to choose the right gasket
- How to get the most out of a gasket

p. 95

I II III 2 3 4

What About Fuel Injection?

As a replacement for conventional carburetors, this new development could produce some very significant changes in the motor gasolines of the future.

Six important trends that could take place are detailed for you by Associate Editor V. B. Guthrie in this month's lead feature article. He then gives you a fast-reading, concise description of each of the three fuel injection systems available commercially today—offered by General Motors, Bendix, and American Bosch.

This is must reading if you have anything at all to do with gasoline manufacture. **p. 59**

I III 1 3 5

Technical Tips for You

The latest, up-to-the-minute information from today's operators and engineers. The second in our 1957 series of articles from the popular question-and-answer session of the WPRA fall meeting. See "Catalytic Cracking." **p. 63**

I 2 3 4

Going into Radiation?

Here are nine important questions, and the answers you'll need to start your own program; covering such aspects as safety, training, insurance, medical arrangements, and laws. By Robert G. Gallaghar. **p. 68**

I II III 3 5

A McGRAW-HILL PUBLICATION

ABP ABC AUDITED PAID CIRCULATION

Member of Associated Business Publications and Audit Bureau of Circulations

Petroleum Processing is published monthly by McGraw-Hill Publishing Co., Inc., James H. McGraw (1860-1948) founder.

Executive, Editorial and Advertising Offices: McGraw-Hill Building, 330 West 42nd St., New York 36, N. Y. Publication Office: 871 N. Franklin St., Chicago 10, Ill. Donald C. McGraw, President; Joseph A. Gerardi, Executive Vice-President and Treasurer; John J. Cooke, Secretary; Nelson Bond, Executive Vice-President, Publications Division; Ralph B. Smith, Vice-President and Editorial Director; Joseph H. Allen, Vice President and Director of Advertising Sales; A. R. Venezian, Vice-President and Circulation Coordinator.

Subscriptions: Address correspondence to Petroleum Processing, Subscription Service, 330 West 42nd St., New York 36, N. Y. Subscription rates: domestic single copies, 35¢, U. S. and possessions, Canada, and all other countries, $2 per year. Orders must indicate company and position.

Published prior to Sept. 1946 as the Technical Section of National Petroleum News, devoted to Refinery Management and Petroleum Chemical Technology, and including International Petroleum Technology.

Second class mail privileges authorized at Chicago, Ill. Printed in U.S.A. Copyright 1957 by McGraw-Hill Publishing Co., Inc. All rights reserved.

n Processing for March, 1957

THIS MONTH'S M&C

You Can't Have Good Maintenance

. . . unless you've developed a definite understanding of the areas of responsibility between maintenance and process functions. Here is a complete discussion of the staff-line relationship at Cities Service by mechanical superintendent and M&C Panelist Roy W. Best in his article, "Cooperative Relations—How They Make for Good Maintenance." p. 75

And this month's M&C Problem Corner discusses how to reduce the problem of excessive wear in herringbone gear pumps being used to transfer oxidized asphalt. p. 77

I II III 4

What's Ahead for the Valley?

Growing faster than the rest of the nation's refining capacity, the Delaware Valley—Philadelphia area will hit 893,500 b/d by the end of 1957. Here's a special 8-page review of this important area by Stuart D. Boynton. p. 78

I 1 2 3 4 5

Low-Finned Exchanger Tubing

The second in a series of three articles for design engineers by Robert G. Newell providing basic heat transfer coefficient data covers design methods checked against performance of this tubing in a petrochemical unit. p. 86

I II III 2

Keep Your Data Up-to-Date

Are you using the "Clip-n-File" departments to full advantage? This month's Process Data Sheet, No. 16, p. 119, covers nitric acid, and the Engineering Data Sheet, No. 15, p. 139, gives you data on combustible vapors.

I II III 1 2 3 4 5

Frenchy, the Crawfish, and Me

Your Bull Pen episode in this issue tells how a Cajun boy who really knew his levees helped solve a problem of a leak in a fresh water reservoir at the Old Man's refinery. For a pleasant five minutes' reading, turn to p. 129

I II III 1 2 3 4 5

AND IN THE FUTURE

Watch those Upcoming Issues

Keep your eyes peeled for the postman. You won't want to miss a single copy. You'll be getting a continuous flow of new, and valuable informative articles . . .

- What the industry and government groups think about the current way asphalt is made and specified—a responsive follow-up to the highly topical January article on the surge ahead for asphalts because of the big road building program.
- Something new! A special industry report on the refining portion of the petroleum processing industries.
- A new series of articles on thermodynamics in hydrocarbon processing.

DEPARTMENTS

Advertisers' Index	170	Patents	153
Books for Oil Men	161	Personals	143
Bull Pen	129	Plant Practices	123
Editorials	204	Process Data Sheet	119
Engineering Data Sheet	139	Publisher's Page	7
Equipment—What's New!	173	Readers' Service Card	171
Information Offered	168	Statistics	165
Letters	18	Suppliers' News	147
Meetings for Oil Men	133	Tomorrow	15
New Words	131	What's Happening	9
Operating Trends	165	What's New!	173

Continue "Readers' Guide" on p. 115

HOW TO USE IT:

Your new "Readers' Guide to What's New in PETROLEUM PROCESSING" will do two things for you. First, the key numbers with each article will tell you at a glance if it is within your scope of interest: roman numerals indicate industries; arabic numerals show fields of activity. Secondly, the longer descriptions will tell you what each article is about, and why it can be of help and interest to you—THE EDITORS

Advertisement

ETHYL STUDY ANALYZES INDUSTRY OCTANE POTENTIAL TO 1960

New report can help in your future refining plans

by **C. J. WOLF,** Ethyl Corporation Refinery Technologist

Ethyl Corporation has undertaken this study to evaluate the effects of present and future refinery processes on the antiknock quality of the motor-gasoline pool in the United States.

The octane potential of the United States refining industry from 1955 to 1960 has been analyzed for the United States as a whole and, separately, for the various regions—East, Midwest, Gulf, Rocky Mountain, and West Coast. The effects of present and future refinery processes in general, and the catalytic reforming process in particular, have been the primary variables evaluated.

Secondarily, changes in crude type, the ratio of domestic-to-foreign crude run, and the composition and disposition of those products from petroleum that influence the quality and yield of gasoline have also been taken into account.

Influence of refining techniques

ETHYL studies indicate that the octane number of the total motor-gasoline pool in the United States increased by 0.9 Research octane number (RON) and by 0.8 Motor octane number (MON) from the fall of 1955 to the fall of 1956.

During this period, the portion of the U.S. refining industry utilizing catalytic reforming increased from 66 to 81 per cent (based on projected crude-running capacity). Total catalytic-reforming capacity, including spare capacity, increased from 10.6 per cent of crude run in 1955 to 12.9 in 1956.

Industry saturation of catalytic reforming in this country as a whole has been estimated at 16.0 per cent of crude run. This saturation is for virgin-naphtha feed only, and it is estimated that it will be reached in the fall of 1957.

Saturation of catalytic reforming is expected to take place by this time in all regions of the U.S. except in the Rocky Mountain region, where saturation is forecast for the fall of 1958.

The octane potential after the fall of 1957 will primarily be influenced by the severity of catalytic reforming, catalytic reforming of heavy thermal naphtha, aromatic extraction with raffinate recycle, and maximum use of alkylation for motor fuel after compliance with aviation-gasoline demand.

A summary of the catalytic-reforming growth in the United States is presented in the table below.

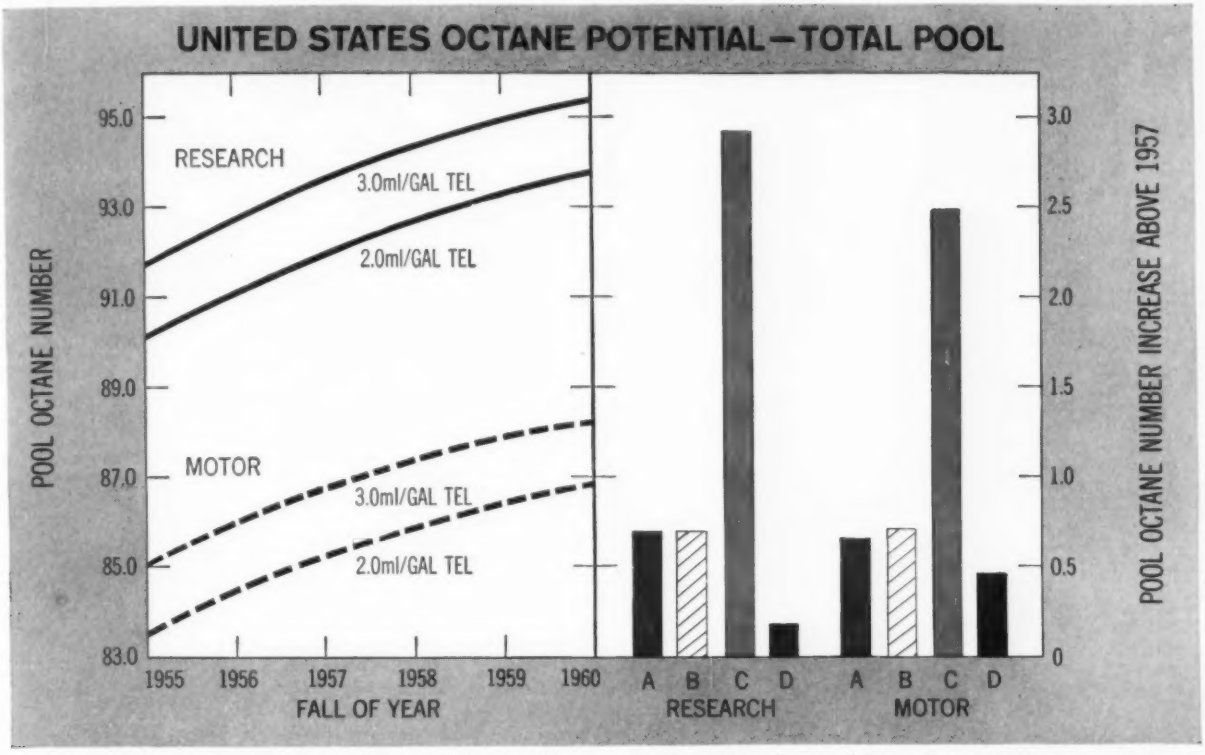
The effects of the growth or decline of refinery processes other than catalytic reforming during the 1955-1960 period have also been evaluated in this study. Growth is expected in catalytic cracking, catalytic polymerization, and alkylation in terms of percentage of crude run during this period. In the same terms, decline is expected in thermal operations—visbreaking, coking, and thermal cracking.

CATALYTIC REFORMING

Per Cent of Crude Run

Fall of Year	1955	1956	1957
East	9.4	11.7	17.0
Midwest	11.0	13.1	16.9
Gulf	10.8	13.7	15.1
Rocky Mountain	1.9	7.2	11.9
West Coast	12.7	13.7	15.9
Total U. S.	**10.6**	**12.9**	**16.0**

(To obtain more data on advertised products see page 170)



The weighted regional-pool octane number potentials of total U.S. pool gasoline are shown from 1955 to 1960. The maximum octane increases obtainable from: **A.** increased reforming severity, **B.** reforming heavy thermal naphtha, **C.** aromatic extraction and reforming raffinate from straight run charge, and **D.** maximum alkylation are shown for the total U. S. gasoline pool. The weighted proportions of these refinery processes in use after 1957 were calculated from projected refinery economics.

Thermal reforming, with the exception of that planned for use in conjunction with catalytic reforming, has been considered to be non-existent when saturation of catalytic reforming of virgin-naphtha is achieved in 1957.

Increases after 1957

AFTER 1957, the maximum octane increase obtainable by more severe catalytic reforming, use of reforming capacity for heavy thermal-naphtha charge, aromatic extraction and raffinate recycle, and maximum alkylation will be about 4.6 RON and 4.2 MON for the total United States.

Depending on the region, this maximum potential octane increase can range from 4.2 to 5.2 RON and from 3.8 to 5.0 MON. The amount of this maximum potential octane increase that is actually employed by 1960 will vary from region to region.

Use of the above-cited refinery processes by 1960 could increase antiknock value of the total 1957 United States pool by about 1.7 RON.

The costs of octane improvement and local area conditions will dictate relative use of these more severe refinery operations.

In general, it is felt that increasing reforming severity to average a yield of about 80 per cent debutanized reformate will be almost universally employed throughout the industry by 1960.

The use of aromatic extraction and raffinate recycle and of catalytic-reforming capacity for heavy thermal-naphtha charge will be practiced by only one-third of the industry in 1960. It is believed that use of these processes will vary between 0 and 40 per cent, depending on the region.

Maximum alkylation above and beyond that required for aviation gasoline will be practiced by about 20 per cent of the industry as a whole, and in the various regions, with the exception of the Rocky Mountain area.

HOW ETHYL RESEARCH CAN HELP YOU

To assist refiners in obtaining the most economical routes to high-octane fuels, Ethyl Research maintains a close watch on trends in refinery processing. Recent studies of crude sources, processing and product yields provide a realistic evaluation of the octane potentialities of motor gasolines. The major findings are summarized for you here. A complete report entitled "U.S. Refining Octane Potential 1955-1960" is available through your Ethyl Representative.

ETHYL CORPORATION
New York 17, N.Y.

ETHYL
ANTIKNOCK COMPOUND
ETHYL CORPORATION

RESEARCH LABORATORIES:
1600 W. Eight Mile Road, Ferndale 20, Mich.
2600 Cajon Road, San Bernardino, Calif.

(To obtain more data on advertised products see page 170)

ADSCO

ENGINEERED HEAT EXCHANGERS

● Whether they are manufactured to the customer's specifications or to our own recommended designs, ADSCO-Engineered Heat Exchangers are carefully designed and constructed to deliver their full rated capacity and to perform in accordance with the customer's process needs. Consult ADSCO's engineering department for recommendations, drawings or estimates on heat exchangers which meet your specific problem.

Shown above, thermosyphon reboiler; float-head, removable bundle type, for refineries at Westville, N. J., and Lawrenceville, Ill.

ADSCO ENGINEERED PRODUCTS

ADSCO INDUSTRIES, INC.

EASTERN PLANT
Alberger Heater Division
20 MILBURN ST., BUFFALO 12, N. Y.

WESTERN PLANT
California Steel Products Division
BARRETT AVE., RICHMOND, CALIF.

Petroleum Processing

A McGRAW-HILL PUBLICATION
Editorial and Business Offices:
330 West 42nd St., New York 36, N. Y.
Telephone: ..... LOngacre 4-3000
Teletypewriter ..... NY 1-2325

Harry L. Waddell—Publisher
William F. Bland—Editor

Editorial Staff

William C. Uhl ..... Managing Editor
Virgil B. Guthrie ..... Associate Editor
Robert L. Davidson ..... Associate Editor
Willis A. Bussard ..... Assistant Editor
Alan Corneretto ..... Assistant Editor
Stuart D. Boynton ..... Assistant Editor
Anita Walter ..... Editorial Assistant
Ronald E. Cannon ..... Southwestern Editor
W724 Prudential Bldg., Houston 25

Illustration Staff

William A. Caperell, Jr. ..... Art Director
Mildred J. Schutte ..... Assistant

Editorial Service Staff

Harriet Costikyan ..... Editorial Research
Jeanne Wolff ..... Reader Service

Business Staff

K. W. McKinley ..... Advertising Sales Manager
Richard H. Loyer ..... Circulation Manager
John E. Thompson ..... Production Manager
L. W. Nelson ..... Advertising Makeup
George Reid (Houston) Assistant to the Publisher
(For Regional Sales Representatives, see listing on Advertisers' Index page)

Domestic News Bureaus

Cleveland 15, Ohio, 1510 Hanna Bldg. Robert E. Cochran, *Bureau Chief;* William G. Meldrum, Michelle M. Perry
Dallas 1, Texas, Vaughan Bldg. Kemp Anderson, Jr., *Bureau Chief*
Detroit 26, Mich., 856 Penobscot Bldg. Harry Homewood, *Bureau Chief*
Los Angeles 17, Calif., 1125 W. 6th St. John K. Shinn, Michael J. Murphy, Barbara Jean Moskowitz
San Francisco 4, Calif., 68 Post St. Margaret Ralston, *Bureau Chief;* Jenness Keene, Sue Thompson
Washington 4, D. C., National Press Bldg. George B. Bryant, Jr., *Bureau Chief;* Andrew R. Patia, N. B. Musselman, Dean Reed

Foreign News Bureaus

John Wilhelm, *Manager,* Mc-Graw-Hill World News
London EC 4, England, 95 Farringdon St. William Coughlin, *Bureau Chief;* John Tunstall, Morrie Helitzer, Edith Walford
Paris 7e, France, 866 Rue de Lille. Robert Farrell, *Bureau Chief;* Helen Avati
Bonn, Germany, Mittelstrasse, 39, Bad Godesberg. G. Schroeder, *Bureau Chief;* Thomas Berendt, Silke Brueckler
Mexico City 1, D. F. Mexico, Madero 16. John H. Kearney, *Bureau Chief*
Rio de Janeiro, Brazil, Av. Franklin Roosevelt 194. Peter Weaver, *Bureau Chief*
Caracas, Venezuela, Avenida Miranda, No. 4. John Pearson
Tokyo, Japan, 14 Azabu-Hiroo-cho, Minato-ku. Daniel Kurzman, *Bureau Chief*
Beirut, Lebanon, P. O. Box 2611. O. M. Marashian, *Bureau Chief*

Other McGraw-Hill Petroleum Publications
National Petroleum News
Petroleum Week
Platt's Oilgram News Service
Platt's Oilgram Price Service

Dear Reader...

. . . Stop printing that junk! No reader has ever written us a letter in quite those words, but we have had a few that came close.

The point is—we LIKE comments about our work as editors. You should write us sometime. We like to hear from readers, because, when you get right down to it, PETROLEUM PROCESSING is edited for people. It's an industry magazine, but it takes people to make an industry.

Why should you write us? Certainly not because we like to get letters, not to flatter our ego. But to get something off your chest. Editors by nature are good listeners. They make good sounding boards. And they frequently can prove helpful.

What should you write us about? Take a look at p. 18 in this issue for some examples. Most letters we receive fall into five broad groups:

Complaints—I put this one first not because it's most important but because it covers the universal subject—the one thing that moves most people to letter-writing. If your copy of PETROLEUM PROCESSING is missing pages, if the issue arrives all banged up, if you don't like the way we do things—say so. Maybe we can do something about it. And we like complaints. They keep us on our toes.

Compliments—These are nice, too—particularly when they are sincere and thrown in to temper a criticism.

Comments—Here we really love you. If you disagree with what we say in an article or an editorial, if you have further thoughts on the subject—fire away.

Ideas—Maybe you have one for a story you'd like to write—or which you think we should do. We're always looking for these—and welcome them.

Questions—We certainly don't know all the answers. But we have access to a lot of information and we may know where to go for the answer.

Whatever the subject—you'll always find us eager to hear from you. If you know someone on our staff, address your letter to him. If you don't know one of our editors, and can't remember my name—just write "Dear Editor:—."

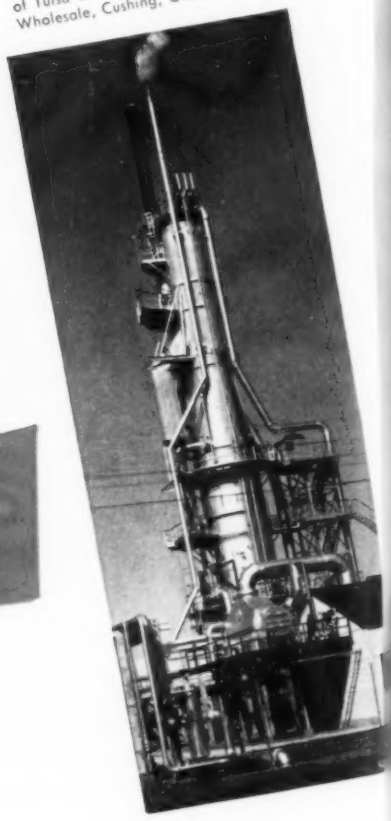
William F. Bland

—Editor

Reactor-regenerator for UOP Catalytic Cracking Unit furnished through Refining Engineering Co. of Tulsa for Kanotex Refining Company, Arkansas City, Kansas.

Reactor-regenerator and two cat hoppers built for Rock Island Refining Company at Zionsville, Ind.

UOP reactor-regenerator built for the Refining Engineering Company of Tulsa at Midland Cooperative Wholesale, Cushing, Oklahoma.



REFINERY BEAUTY

UOP reactor-regenerator unit furnished for the Ben Franklin Refining Co., Ardmore, Oklahoma.

Regenerator, part of a Model IV Catalytic Cracking Unit, furnished through Fluor Corporation Ltd. for Standard Oil Company of California, El Segundo, California.

Where there are refining operations there are sure to be welded steel plate structures built by CB&I. Pressure vessels, cat crackers, Hortonspheres®, Hortonspheroids®, Horton® Floating Roofs and others . . . refinery structures built to exacting specifications by skilled craftsmen.

When *you* plan refinery structures, write our nearest office for information, estimates or quotations.

CB&I

Chicago Bridge & Iron Company

Atlanta • Birmingham • Boston • Chicago • Cleveland • Detroit • Houston
Los Angeles • New York • Philadelphia • Pittsburgh • Salt Lake City
San Francisco • Seattle • Tulsa

Plants in BIRMINGHAM, CHICAGO, SALT LAKE CITY and GREENVILLE, PA.

REPRESENTATIVES AND LICENSEES:
Brazil • Canada • England • France • Italy • Netherlands • Scotland • Venezuela

WHAT'S HAPPENING

In demand, stocks, trends

	1957 Feb.	1956 Feb.	% Change
Runs to still	7.996	8.045	− 0.6
Demand			
Gasoline	3.625	3.374	+ 7.4
Middle dist	3.052	2.879	+ 6.0
Residuals	1.939	1.912	+ 1.4
Stocks			
Gasoline	203.804	194.473	+ 4.8
Middle dist	107.499	90.999	+18.1
Residuals	36.883	36.907	0

(Figures are in million b/d, API data)

For more details, turn to p. 165, this issue.

In refining

. . . **Six significant changes in gasoline patterns** could result from the widespread adoption of fuel injection in place of conventional carburetors in near-future automobiles. And there are three fuel injection systems commercially available today.

The possible changes include:

- A slowdown in the octane race.
- A boost in gasoline economy.
- Elimination of the need for distillation range variations for seasonal or geographical reasons.
- Use of heavier fractions than present-day specifications allow.
- Use of more of the higher boiling aromatics.

For further discussion and a description of the new fuel injection systems, see pp. 59-62 in this issue.

. . . **British Petroleum (Canada) Ltd.** plans to build a 30,000 b/d refinery at Montreal, Canada (see PETROLEUM PROCESSING, Dec., 1956, p. 9). Reported cost will be $30-million, and the refinery will use Kuwait crude. Construction will start this spring.

. . . **Alaska-Yukon Refiners & Distributors Ltd.'s** new Haines, Alaska, refinery (see PETROLEUM PROCESSING, Jan., 1957, p. 10) is now reportedly planned for 6500 b/d capacity with 2500 b/d thermo-cracking capacity. Completion is due in 1958.

. . . **British American Oil Co.** has awarded contract to Fluor Corp., Ltd., for $4-million for offsite facilities to serve a new reformer and crude unit being built at BA's Clarkson, Ont., refinery.

. . . **Farmers Union Central Exchange** plans to spend $3-million at its 19,000 b/d Laurel, Mont., refinery, primarily for a 7000 b/d Unifiner and a 4500 b/d Platformer. Completion is set for spring-1958.

. . . **West Coast refiners** will be assured of an ample supply of crude when the new 600-mile, Utah-Los Angeles crude oil line planned by Four-Corners Pipe Line Co. is completed. The line will cost an estimated $50-million and will have an initial capacity of 60,000 b/d, with an ultimate capacity of 160,000 b/d plannned. Four-Corners is owned by Continental Pipe Line Co. (10%), Gulf Oil Corp. (20%), Richfield Oil Corp. (10%), Shell Oil Co. (25%), Standard Oil Co. of Calif. (25%), and Superior Oil Co. (10%).

. . . **Imperial Oil Ltd.** plans to spend $17-million to double the capacity of its Calgary, Alta., refinery to about 18,500 b/d—contingent upon final approval by Calgary city authorities.

. . . **Kerr-McGee Oil Industries, Inc.** plans a 4000 b/d Unifiner and a 5500 b/d Platformer at its Wynnewood, Okla., refinery.

. . . **Shell Development Co.** is entitled to a patent on its TCP gasoline according to a court decision. (See p. 153 in this issue).

. . . **Skelly Oil Co.** will build a 3000-4000 b/d Perco HF alkylation unit (Phillips Petroleum Co. license) at its El Dorado, Kans., refinery. Completion is due in early-1958.

. . . **Standard Oil Co. (Calif.)** plans to spend about $66-million during 1957 to expand capacity and improve output quality for refining and chemical manufacturing facilities in the U.S.

. . . **Standard Oil Co. (Ind.)** will no longer make candles at its Whiting, Ind., refinery. The original candle factory was completed in 1893 and was closed in mid-1956.

. . . **Tidewater Oil Co.'s** Delaware City, Del., refinery has contracted for Panellit Service Corp. to maintain the refinery's instrument and control systems. Earlier, Tidewater contracted for Catalytic Construction Co. to handle other routine and turnaround maintenance.

. . . **Union Oil Co. of Calif. and the U.S. Navy** apparently have concluded that for shale oil to be competitive with crude petroleum, the emphasis should be on diesel and jet fuels—not gasoline—production.

. . . **Free-world** petroleum industry investment for foreign fixed assets by American companies was $8-billion (or 35% of the total) by the end of 1955, according to F. C. Coqueron and J. E. Pogue, Chase Manhatten Bank. Distribution of American investment participation was Canada 54%, Venezuela 61%, Western Europe 26%, Middle East 47%, and

other countries 22%—accounting for 55% of production and 40% of refinery runs.

. . . **Other new construction projects,** indicated by recent fast tax write-off approvals, are

- California Oil Co., Perth Amboy, N.J., $1,260,000 for expansion of catalytic reforming unit.
- Wilshire Oil Co., Norwalk, Calif., $2,735,000 for oil refining facilities.

In gas liquids recovery

. . . **Magnolia Petroleum Co.,** operator for the new Spivey gasoline plant in Harper County, Kans., has announced that the plant started operations on February 15. Daily production will start at 21,000 gal natural gasoline and 26,000 gal LPG from processing over 55-million cu ft/d of gas. The plant is owned by 58 producers in the Spivey-Grabs area.

. . . **Sinclair Oil & Gas Co.** is expanding facilities at its Gas Products Plant No. 27, near Sweetwater, Texas. A fourth compressor, 500-hp, will have a capacity of 1.8-million cu ft/d, bringing the total plant capacity to 9-million cu ft/d.

. . . **Esperance Point Gasoline Corp.,** a new firm of Shreveport, La., has its $200,000 plant onstream at Esperance Point, La. The plant will process about 2.5-million cu ft/d casinghead gas to produce about 7500 b/d gasoline.

. . . **La Gloria Oil & Gas Co.** will add three absorbers and related equipment to increase LPG production by 50%—to 6,500 b/d.

. . . **Continental Oil Co.** will build the first natural gasoline plant in Short Junction field, near Oklahoma City, Okla. The $1.8-million plant will process 60-million cu ft/d gas, and is being built by Tuloma Builders, Inc., of Tulsa, Okla., with completion due by June.

In petrochemicals

. . . **Allied Chemical & Dye Corp.** says that detailed announcements about its 2-year research on low pressure polyethylene will be forthcoming shortly.

. . . **Apache Powder Co.** is adding a 30 t/d ammonia synthesis plant at Curtiss, Ariz. Girdler Co. will design, engineer and start up the $1-million unit, using catalytic reforming of natural gas.

. . . **Calcasieu Chemical Corp.'s** $11-million plant at Lake Charles, La. (see PETROLEUM PROCESSING, Feb., 1957, p. 10) will use Shell Development Co.'s ethylene oxide process and will be built by Lummus Co.

. . . **Du Pont Co.'s** Belle, W. Va., works has completed temporary equipment to facilitate its switch from coal to natural gas for nylon manufacture (see PETROLEUM PROCESSING, Sept., 1956, p. 10). Present equipment furnishes 10-million cu ft/d of gas, with the over-all program to be completed in 1959 for the entire 31-million cu ft needed.

. . . **Goodrich-Gulf Chemicals, Inc.** plans to convert a production line to make 50,000 t/yr of Ameripol "cold" rubber at its Institute, W. Va. plant. The changeover from present rubber-making process will cost over $2-million and is set for completion by early-1958.

. . . **Ethyl Corp.** has begun preparation of the site for a West Coast "antiknock compounds" plant at Pittsburg, Calif. The plant, engineered by C. F. Braun & Co., is due onstream mid-1958.

. . . **Esso Research & Engineering Co.** has been licensed to use Dow Chemical Co.'s butadiene process. First unit for Esso will be at Esso Petroleum, Fawley, England, with onstream due in 1958. The process, a joint development of Polymer Corp. and Dow, is already in use at Polymer's Sarnia, Ont., synthetic rubber plant.

. . . **Monsanto Chemical Co.** now pipes natural gas to its Texas City, Texas, plant from a company-owned gas field 40 miles away in Brazoria County, Texas. An important part of the plant's requirements for fuel and acelylene production are supplied by the new line.

. . . **Standard Oil Co. (Ind.)** has purchased Schrock Bros. Co., fertilizer firm at Congerville, Ill. Schrock will be an affiliate chiefly to sell anhydrous ammonia in Ill., Ind., Ia., Neb., and Kans.

. . . **The Texas Co.** is making di-isobutylene at its Port Arthur, Texas, refinery. Initial capacity will be 8-million lb/yr, with possible future expansion.

In transition

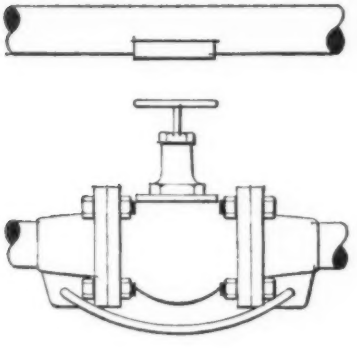
. . . **Panhandle Eastern Pipe Line Co.** has purchased Century Refining Co., a 2000 b/d skimming and cracking plant at Shallow Water, Kans.

. . . **Canadian Husky Oil, Ltd.** is now whole owner of Husky Oil & Refining, Ltd. Canadian had owned about 60% of Husky Refining since 1953.

. . . **Anderson Refining Corp.,** a new Dallas, Texas, firm, has purchased a refinery near Palestine, Texas, from Corpus Christi Refining Co. The refinery has been idle for 18 months.

. . . **Standard Oil Co. (Ind.)** has now reorganized nine wholly-owned affiliates into four operating companies "to increase efficiency and economy," and combined crude buying of three former subsidiaries

With this new round shape, UNITRACE costs substantially less per foot. And since the steam passage has less outside wall area, external radiation heat loss is reduced. The need for thermal insulation is often eliminated. When insulation is used, it costs less because standard pre-formed pipe covering can be used.
to cut costs,
boost efficiency
of steam traced pipe...
ALCOA UNITRACE has a NEW SHAPE
for lower cost per foot...
easier joining...
less heat loss...better
internal heat transfer



Sections of UNITRACE in the new shape can be easily and quickly joined by the weld and patch method (top). And a brand new UNITRACE flange—with product and steam passages cast as integral parts of the flange—simplifies installation of valves (center) and other flanged connections (bottom).

Want to save money on steam-traced piping? Here's good news for your pocketbook! ALCOA® UNITRACE *has a new cost-cutting shape* . . . a round section matching standard pipe shapes . . . available in 1½", 2", 3" and 4" sizes.

With steam and product passages extruded in a single unit of light, strong, corrosion-resistant Alcoa aluminum alloy 3003-F, UNITRACE completely eliminates the cost of external steam jackets or tracer tubes. And the new UNITRACE shape makes possible these *extra* savings:

Lower cost per foot . . . total volume of metal is less; material costs are lower.

Easier, faster joining . . . new configuration (with exterior grooves for quick steam passage identification) makes mating and joining fast and simple to cut installation costs.

Less external heat loss . . . improved internal heat transfer . . . the new design reduces area for external radiation loss.

The natural corrosion resistance of aluminum makes UNITRACE ideal for handling naval stores, molten sulfur, ammonium nitrate solutions, glacial acetic acid, fatty acids, tar, pitch, wax, urea and similar products which normally require heated transfer lines.

Find out today how *you* can use ALCOA UNITRACE to cut costs and improve efficiency of your heated transfer lines. Call your nearest Alcoa sales office, or write Aluminum Company of America, 893-C Alcoa Building, Pittsburgh 19, Pennsylvania.

ALCOA ALUMINUM
ALUMINUM COMPANY OF AMERICA

THE ALCOA HOUR
TELEVISION'S FINEST LIVE DRAMA
ALTERNATE SUNDAY EVENINGS

Write for this FREE BOOKLET!
This new, illustrated booklet contains complete engineering, specification and fabrication data on ALCOA UNITRACE in the new shape. It's your guide to low cost heated transfer lines. Write for it today!

(To obtain more data on advertised products see page 170)

into a fifth company. Surviving companies are: Pan American Petroleum Corp. (production), American Oil Co. (eastern and southern refining and marketing), Service Pipe Line Co. (crude pipe line transportation), Amoco Chemicals Corp. (chemical manufacturing and sales), Indiana Oil Purchasing Co. (crude purchases and sales).

In foreign operations

. . . . Britain and Europe

Kohle-Oel Chemie A.G., jointly set up by Deutsche Erdoel (Hamburg), Mannesmann (Dusseldorf), and Farbwerke Hoeschst (Frankfort) will build a new polyethylene plant near Gelsenkirchen to cost $23.8-million.

N. V. Bataafsche Petroleum Maatschappij of the Hague, operating company of the Royal Dutch Shell group, has developed a new process to convert oil under pressure into synthesis gas for ammonia manufacture. The first plant to use the process is at Ijmiden (Holland), while a second one is being built at Shell Haven, England.

The new Purfina Italiana—Anic refinery near Rome, Italy (see PETROLEUM PROCESSING, Feb., 1957, p. 12), will have 60,000 b/d capacity, replacing Purfina's present 8000 b/d refinery near Rome.

. . . Latin America

Petrobras (Brazil) gave The Texas Co. a 5-year contract to supply 15,000 b/d crude for Petrobras' projected Rio refinery, in return for a $6-million loan to help finance the 90,000 b/d plant.

. . . The East

Ceylon officials will receive a new offer for a refinery project by the previously rejected Shell-BP-Caltex-Standard Vacuum group (see PETROLEUM PROCESSING, Nov., 1956, p. 12). This is in addition to a recent offer by an Indian group (see PETROLEUM PROCESSING, Feb., 1957, p. 12).

Maruzen Oil Co. has opened Japan's first full-scale petrochemical plant at Shimotsu, Wakayama prefecture in Western Japan. The plant will make 300 t/month of secondary butanol from butane and butylene.

Resins, Inc., an associate of Reichhold Chemicals, Inc., is building a plant at Manila, P.I., to manufacture 6-million lb/yr synthetic resins under license from Reichhold.

Syria reportedly accepted Czechoslovakia's bid to build a refinery near Damascus. The decision appears to have been on political grounds.

Standard-Vacuum will increase crude capacity of its 20,000 b/d Durban, South Africa, refinery by 5000 b/d; also will install Powerformer and Hydrofiner. Foster Wheeler will begin work on the 2-year, $9-million job "later this year."

Showa Denko K.K., Japan, has received a license to Phillips' low-pressure polyethylene process.

In markets and prices

. . . Higher product prices that came in the wake of a general crude advance held up fairly well in February, although the lateness of the heating season and over-sensitive gasoline markets were slowly depressing wholesale price lists in several primary districts.

Over-all, refiners generally felt they fared much better in the two-month shakedown period following the January 3 crude hike than in the similar period after the 1953 crude advance.

Cargo quotations for distillates—backed by strong European demand and a tight tanker market—held firm after registering increases totaling 1¢/gal. Bunker "C" fuel was the only major product that escaped an increase at the Gulf, but along the Eastern Seaboard, prices edged higher generally by 25¢/bbl.

In the interior and on the West Coast, product prices also moved higher. Bunker "C" fuel was quoted at $2.65/bbl at San Pedro following a 15¢/bbl boost, while low sulfur No. 6 fuel moved up 8.85¢/gal in Chicago.

. . . Biggest problem of refiners in February was the outlook for gasoline. Despite cutbacks in refinery runs in conjunction with moving more crude to Europe, stocks remained at peak levels, and post-crude advances in a few areas fell apart at the seams.

At the Gulf, refiners were hoping that big spring demand would set in early enough to backstop earlier increases of 0.5¢ for high octane material, and up to 0.875¢ for other grades.

In parts of the northeast, earlier advances of 1¢/gal had already been shaved 0.5¢ and there was talk of undercover discounts in the Midwest.

Looking ahead

. . . An investment in the future could describe the Standard Oil Co. (Ind.) plan to pay 75% of tuition, registration, laboratory and other fees for any permanent employe continuing education at accredited schools, colleges, or trade schools.

. . . Natural rubber in "nature's way" has been made by H. Teas of the University of Florida and R. S. Bandurski of Michigan State. The test tube work isolated rubber-forming enzymes and traced the mechanism by radioactive methods. Though not of commercial value, it is hoped the work will lead to better understanding of the synthesis of other chemically related compounds.

More Oil for India... *a year ahead of schedule*

When Burmah-Shell Refineries Ltd. entrusted to The Lummus Company the task of engineering and constructing India's largest oil refinery, a big factor in the decision was Lummus' unique experience — in design and construction, in bringing together men and materials in remote parts of the world, in coping with exigencies of climate and terrain. Burmah-Shell's confidence paid off. 21 months after work began — one year ahead of schedule — the Bombay refinery went on stream, today supplies half of India's petroleum needs.

When a handful of Lummus engineers and supervisors arrived on the site of the Bombay refinery, they found a stretch of water-bound rice paddies and scrubland, without roads, railway or harbor. Some of these specialists recruited and trained native labor — 14,000 in all. Others coordinated the flow of materials from overseas. Then came still other specialists to erect the intricate array of towers and piping that is a modern refinery. Obstacles of terrain were aggravated by Monsoon rains of unusual violence, but work never stopped until the 40,000 barrels per day installation was helping to fuel India's growing industries.

Lummus' half-century of worldwide experience counted heavily in the successful completion of this difficult project. But, even under more normal circumstances, the design and construction of a new plant does not lend itself readily to do-it-yourself solutions. It calls for the integrated abilities of a top-flight engineering and construction company.

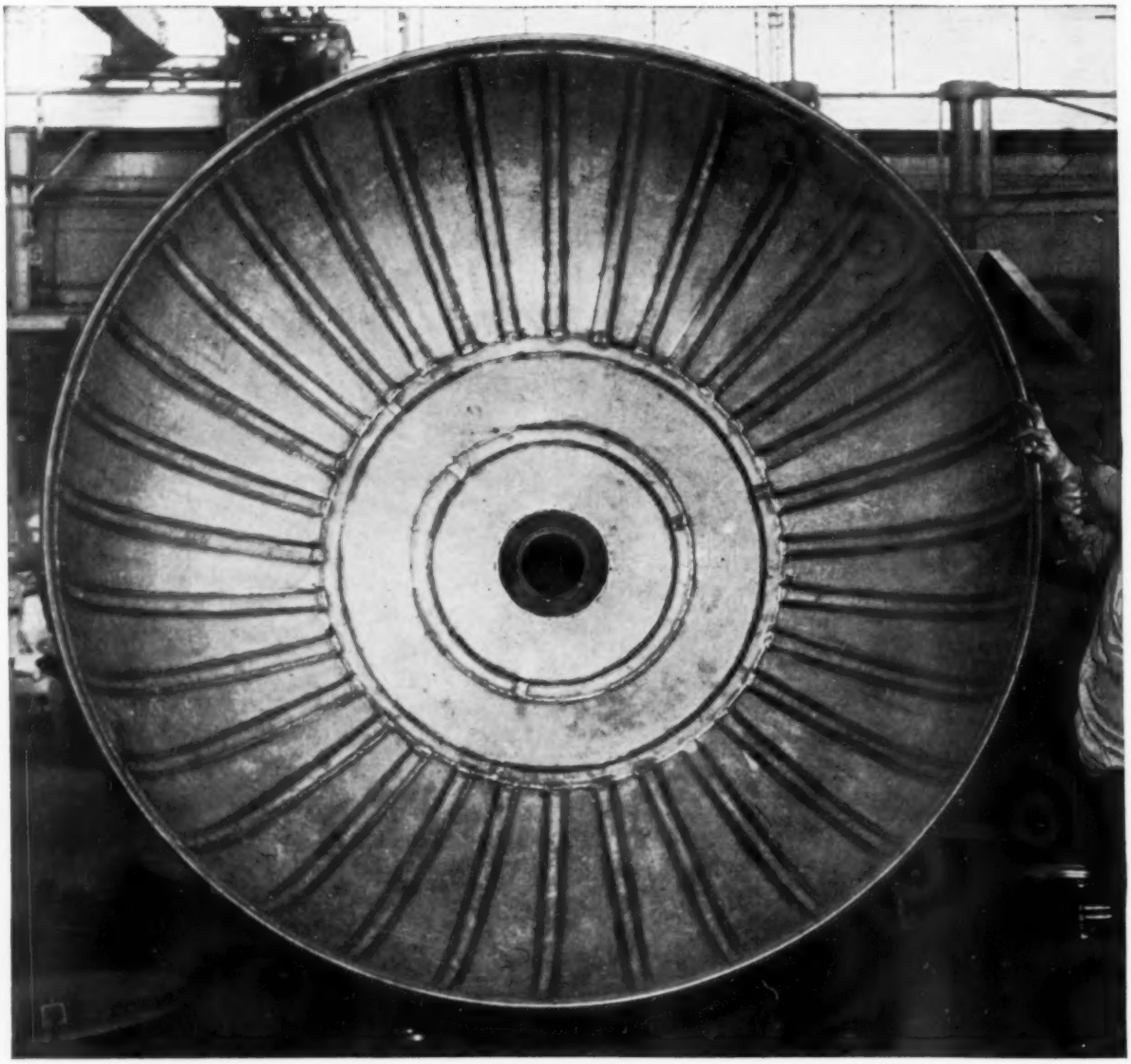
Talk with Lummus when you plan your next project.

THE LUMMUS COMPANY
385 Madison Avenue, New York 17, N. Y.

LUMMUS

ENGINEERS AND CONSTRUCTORS FOR INDUSTRY

NEW YORK · CHICAGO · HOUSTON · THE HAGUE · LONDON · MONTREAL · PARIS



FLYING SAUCER?

Could be . . . considering the craftmanship

This skillfully fabricated head is part of an absorber tower for the production of polyethylene. Of carbon steel with a carefully applied Hastelloy lining, it has proved very resistant to the highly corrosive reactions of gaseous chemicals under conditions of high temperature and pressure. For long-lasting equipment under exacting service conditions, Graver is a reliable source of skilled craftmanship.

ALLOY DIVISION

1857-1957 GRAVER®

A CENTURY OF CRAFTSMANSHIP IN STEELS AND ALLOYS

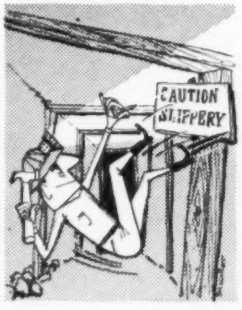
GRAVER TANK & MFG. CO., INC.

EAST CHICAGO, INDIANA • NEW YORK • PHILADELPHIA • EDGE MOOR, DELAWARE
PITTSBURGH • DETROIT • CHICAGO • TULSA • SAND SPRINGS, OKLAHOMA
HOUSTON • LOS ANGELES • FONTANA, CALIFORNIA • SAN FRANCISCO

Can lubricants be mined— as well as refined?

YES! One of the most promising new materials for mechanical lubrication is both mined in Colorado, and recovered as a by-product in copper ore refining.

Molybdenum disulfide is rapidly finding many new uses in mechanical lubrication. The most recent is as a valuable additive to chassis greases and greases used in railroad journal bearings. Its principal advantage is that it clings tenaciously to metal surfaces. When used as an additive to standard greases, it remains to carry on lubrication when the main lubricating medium has been wiped or washed away by mechanical or chemical action.



Molybdenum disulfide—produced from the mineral molybdenite—is a stable chemical compound that is insoluble in water, oils, alkalies, and most acids.

Its outstanding physical characteristic is its laminar structure, which is responsible for its use as a lubricant. Similar to graphite in physical structure, each lamina of molybdenum disulfide is a sandwich of molybdenum atoms between two layers of sulfur atoms. The attractive forces between dissimilar atoms (sulfur and molybdenum) in the same lamina are greater than the attractive forces between adjacent sulfur atoms in separate laminas. As a result of these weak bonds, one layer slides easily over an adjacent one.

But unlike graphite, molybdenum disulfide retains good lubricating properties at high temperatures—up to 750°F in air and above 1500°F in inert atmosphere. It does not weld to the metal at these high temperatures, as does graphite. It also maintains good lubrication under heavy loads. When added to normal hydrocarbon lubricants, molybdenum disulfide has another advantage: It has greater temperature resistance and inertness than the hydrocarbon carriers themselves.

This property makes it a natural for certain applications such as chassis lubrication and journal bearings. When the primary grease is squeezed out by mechanical pressure, or wiped clean by periodic shearing movements, the molybdenum disulfide will remain to guard the equipment until the primary lubricant can be reapplied.

Because molybdenum disulfide has a high affinity for metals, these methods of applying it as a primary, dry lubricant are used: wiping, spraying or dipping. The latter two use a liquid bonding agent to seal the lubricant to the equipment. Heat curing is required in this technique. Of course, when used as a secondary lubricant in a hydrocarbon base, the mixture is applied by conventional methods.

Some of the many uses that have alread proved the advantages of this miracle lubricant are:

- In parts that are hard to lubricate—or where oil or grease contamination can not be tolerated
- Parts requiring lifetime lubrication
- Under extreme operating conditions
- Systems that are exposed to dust and other contaminants that adversely affect grease or oil
- Systems that react unfavorably with conventional lubricants

Molybdenum disulfide also has the advantage of being non-corrosive.

Another interesting application for this new mineral lubricant is as an additive to rubber and plastic compounds. Its addition lowers their coefficient of friction in mechanical parts, such as pump packing, O-rings and shaft seals. Powder metal bearings also profit from the addition of this new mineral lubricant, molybdenum disulfide. —W.A.B.

What? another society? . . . Yes! and this one means business!

OUT OF the profusion of new and old technical societies, a new name is climbing to rapid prominence—The American Association of Cost Engineers, dedicated to the application of scientific principles and techniques to problems of cost estimation, cost control and profitability in the process industries.

The founding fathers of this rapidly growing society are Dr. O. T. Zimmerman (Department of Chemical Engineering, University of New Hampshire) and Dr. Irvine Lavine, both of the Industrial Research Service, Inc. of Dover, N. H. Culminating years of active interest in this field, they "spark-plugged" the formation of the AACE during June 1-2, 1956.

There were 59 charter members including 38 industrial concerns and two government agencies. Today, a little more than one-half year later, the

membership has increased more than four-fold, with membership applications still pouring in.

Some of the more than one hundred industrial concerns now represented by AACE membership include Tidewater Oil Co., Union Oil Co. of Calif., Universal Oil Products Co., Shell Chemical Corp., Shell Development Co., Standard Oil Co. of Ind., Sun Oil Co., The Texas Co., Pure Oil Co., Gulf Research & Development Co., Humble Oil & Refining Co., Lummus Co., Magnolia Petroleum Co., General Petroleum Corp., Diamond Alkali Co., Girdler Co., Gulf Oil Corp., Bechtel Corp., Blaw-Knox Co., C. F. Braun & Co., Catalytic Construction Co., Celanese Corp. of America, Continental Oil Co., Dow Chemical Co., du Pont Co., Esso Research & Engineering Co., Ethyl Corp., and Foster Wheeler Corp.

Membership in the AACE is open to individuals engaged in cost engineering who are graduates of recognized engineering curriculums, or hold licenses to practice professional engineering, or have five years experience in responsible engineering positions. More information about AACE can be obtained from Mr. John T. Husted, Secretary, AACE, P. O. Box 1411, Trona, Calif.

The void in published data for cost engineering is being gradually filled. But much—too much—remains undone. Too many "holes" remain that individual efforts alone cannot fill. Evidence of this can be seen in the "blue-ribbon" list of companies represented by AACE membership. —R. L. D.

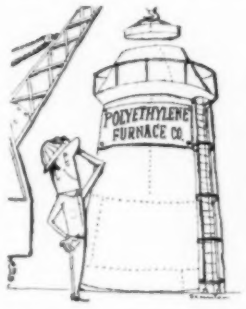
Irradiation may be answer to polyethylene's heat limits

POLYETHYLENE, whose usefulness has been limited by poor resistance to heat, can now be changed by irradiation to produce a plastic ranking with the best in heat resistance. As a result, all sorts of possibilities emerge for this already versatile petrochemical, as well as its raw material, ethylene. All point to continued rapid growth in demand and production.

The first of the improved material to find its way back into refineries and petrochemical plants—as well as virtually every other industry—will be in the form of heat-resistant electrical insulation.

General Electric's Chemical and Metallurgical Division has announced that irradiated polyethylene will be a regular commerical volume product in GE's line of insulation materials (**Business Week,** Jan. 5, 1957, p. 73). A new plant is already in operation that can turn out up to 1.6 million lb/yr of irradiated polyethylene film. Expansion plans call for an ultimate capacity of 3.2 million lb/yr. GE will market the materials under the name "Irrathene."

That 3-million lb capacity will be only a small fraction of the expected 800-million lb/yr production in 1960 (PETROLEUM PROCESSING, Sept., 1956, p. 107), but this is only the first production. Several other researchers have experimented with the material, and are said to be investigating its use for such items as boilable bottles and wire insulation. Other possibilities include use for thermal insulation, gaskets, packing, and building materials.



Ordinary polyethylene, though excellent for insulation, melts at around 212°F. Once it has been irradiated with high energy electrons, its molecular structure is changed, and it will withstand temperatures up to 450°F for short periods, and will last indefinitely at temperatures below 400°F. In addition, the irradiated material has a better "plastic memory," and improved resistance to cracking and swelling.

Along with these advantages, irradiated polyethylene retains most of the properties of the regular plastic—light weight, flexibility, elasticity, and high electrical resistance.

In General Electric's process, polyethylene sheet is zipped through a 2-million electron-volt beam from a resonance-transformer type of cathode-ray generator, similar to the Betatron type of commercial X-ray units manufactured by GE's Transformer Division.

Another example of improved products with a new processing tool—radiation. —R. E. C.

Fast electrons from Van de Graaff "catalyze" bromination of toluene

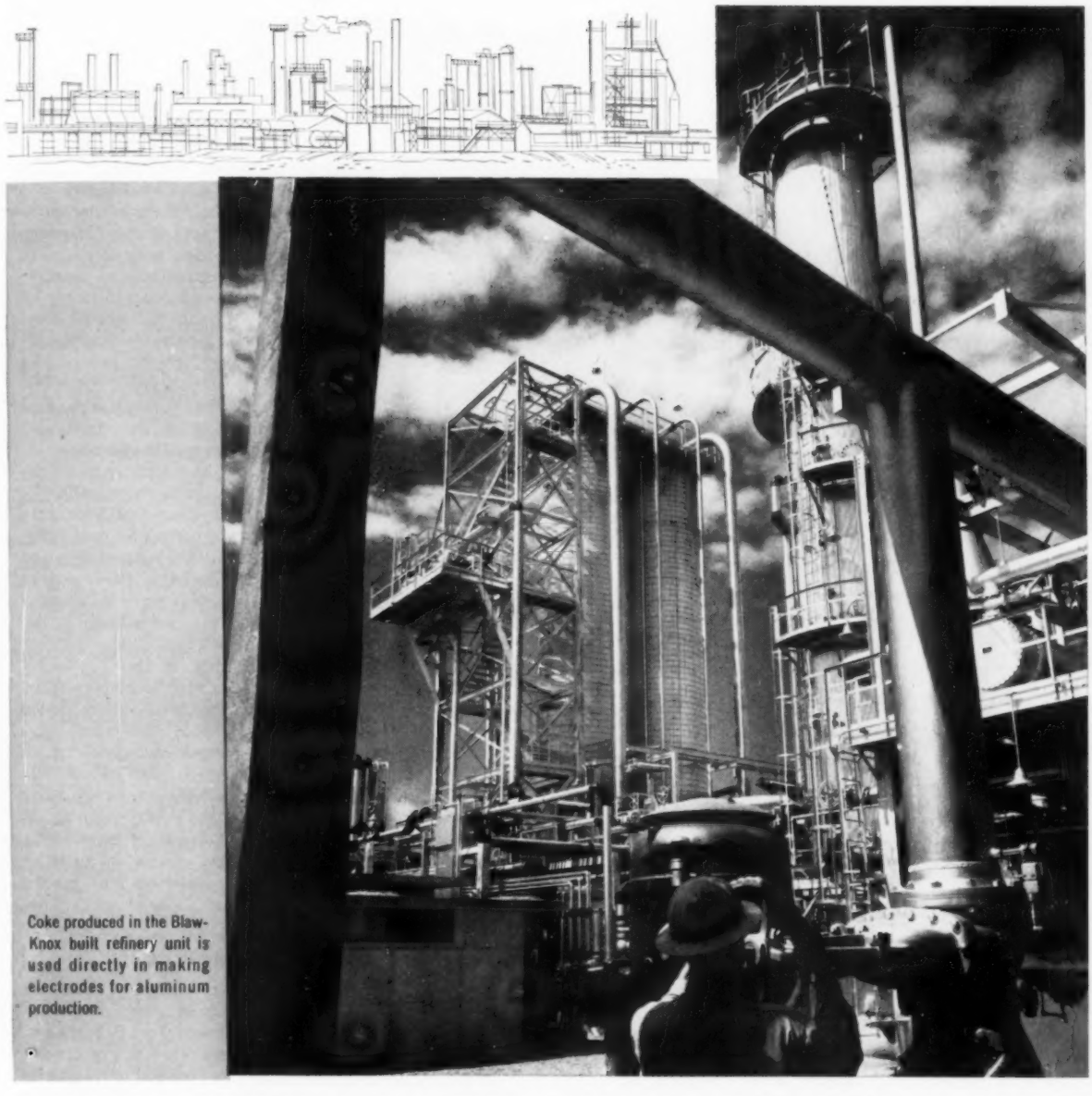
ANOTHER in the fast growing list of "radiation" chemical reactions is the bromination of toluene, reported by R. A. Cox and A. J. Swallow of Cambridge University.

Toluene was brominated with N-bromosuccinimide while being irradiated with fast electrons from a 2-mev Van de Graaff machine.

Yields of 69% benzyl bromide compared favorably with that obtained using dimethly-α, α'-azoisobutyrate as a catalyst.

Details of the technique used are given in "Ionizing Radiation as a Catalyst for Chlorination and Bromination," **Chemistry and Industry,** 1956, Nov. 3, pp. 1277-8 (a British publication).

—R. L. D.



Coke produced in the Blaw-Knox built refinery unit is used directly in making electrodes for aluminum production.

PETROCHEMICALS

are a growing factor in two great industries ... petroleum and chemicals

Wide experience, gained through long association with diversified problems in both petroleum and chemicals, as well as in petrochemicals, enables Blaw-Knox engineers to meet your most exacting requirements in designing, engineering and building plants in all three process areas. When planning new or expanded facilities, investigate how this specialized background can serve you, too.

BLAW-KNOX

BLAW-KNOX COMPANY

Chemical Plants Division

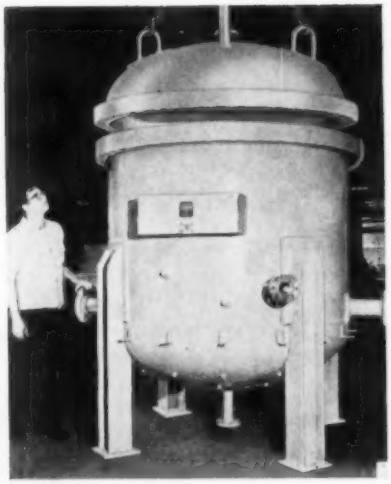
Pittsburgh 22, Pa. • Chicago 1, Ill.

Birmingham • Philadelphia • New York City • San Francisco • Washington, D.C.

Designers, engineers and builders of plants for the process industries: chemicals • petroleum • petrochemicals • resins and plastics • nuclear energy • fats and oils • fertilizers • synthetic fuels

(To obtain more data on advertised products see page 170)

LETTERS



USE *Fulflo* FILTERS

For Continuous Micronic Clarity

IN REFINING, PROCESSING, BULK FILTRATION, DISPENSING

You get *continuous micronic clarity* with Fulflo Filters — for almost any liquid petroleum product including gasolines, fuel oils, petro-chemicals; for almost any operation — refining, processing, bulk filtration, dispensing. Standard models handle all normal flow rates and pressures. Special models are engineered for flow rates as high as 2000 gpm or pressures up to 5000 psi, with minimum pressure drop.

Fulflo employs *genuine* Honeycomb Filter Tubes, with positively controlled densities. For resistance to chemicals, a wide choice of filter media is available — cotton, nylon, orlon, dacron, dynel or acetate. Glass fibre elements resist strong acids and high temperatures. Fulflo does not remove additives from oils.

Commercial Filters products also include a complete line of CFC (formerly Honan-Crane) Filters. They employ a variety of filter media such as Cranite (Fuller's earth) for removal of soluble as well as abrasive contaminants.

Commercial Filters engineers are ready to help you with any problems involving fine filtration of liquid petroleum products. For technical literature, write Department PP.

COMMERCIAL FILTERS
CORPORATION
MELROSE 76, MASSACHUSETTS

Plants in Melrose, Massachusetts and Lebanon, Indiana

Crude oil index

To The Editor: I have read with interest the article on p. 68 of your January issue ["A New Crude Oil Quality Index" by David Rothbard].

In our studies on the desulfurization and improvement of whole crudes, we have come to the definite conclusion that the gravity method for pricing and selling crude oil is inadequate.

We believe Mr. Rothbard's approach is a sound one, but in need of refinement. One point, of course, that occurred to us was that he does not allow a factor for the sulfur content of the various crudes. This may be partially overcome by the significant tests of the cuts that would be affected somewhat by the sulfur content.

J. B. Allinson
President
First Development Corp.
Dallas 2, Tex.

To The Editor: . . . Simple and reasonably accurate indices are certainly needed by the petroleum industry. Mr. Rothbard's method has merit. However, it seems to lay too much stress on the value of lubricating oils. It would be interesting to see the effect on Mr. Rothbard's index if heavy catalytic cracking charge stocks and coker charge stocks were evaluated.

M. D. Haynes
Tidewater Oil Co.
Delaware City, Del.

To The Editor: Mr. Rothbard has undoubtedly made a considerable contribution to the evaluation of crude oils. The advantage of his method over using the API gravity of the crude cannot help but be advantageous. It is, of course, understood that the evaluation of a crude for refinery use is dependent upon the specific uses to which the crude is going to be put; which in turn depend upon the equipment available to the individual refinery.

A. W. Lewis
Tidewater Oil Co.
Delaware City, Del.

● *Here is author David Rothbard's reply to the preceding comments:*

The "Quality Index" method deals with the API gravity and yields of crude oil fractions reflecting those finished products that enjoy substantial market demands. Including cracking or coker charge stock would in no way enhance the effectiveness of the method. This is because of the following. The gas oil fraction is generally used for producing fuel oil and as cracking charge. The characterization factor inferentially points up the gas oil composition with respect to paraffinicity (which in turn largely governs its cracking characteristics).

Adding a factor for sulfur content would require test for this constituent in crude oil. This would add confusion without aiding the effectiveness of the method. Properties such as sulfur or salt content and others that cause serious refinery problems are now being solved satisfactorily by equipment and technological research. They present little or no problem on a widespread national, or even international, commercial scale.

The effectiveness of the Quality Index method can best be demonstrated by comparing the classifications of the 96 crudes in Table 3 of the article with refinery experience and knowledge gained through years of research, development, and operations regarding their respective qualities. I believe such a study should result in establishing the Quality Index method as an effective means for grading and pricing crude oils.

Keeps falling apart

To The Editor: For the past six months I have been a very interested reader of Petroleum Processing, and so are many other staff members of our company. We enjoy the useful data that can be found in the many informative subjects covered.

Now the impression I get from reading your magazine is that you do from time to time appreciate hearing from your readers, how well the magazine is being received, and what we think of the book generally.

As an interested reader, may I be permitted to criticize the front and back cover. Out of eight copies I've received so far, there is not one which still has the front cover attached to the book. After the magazine arrives in its envelope and is removed for the initial opening, the covers begin to show signs of tearing.

You may consider that I am being unduly fussy, but I can assure you that I think a book without this dress-

(To obtain more data on advertised products see page 170)

ing looks most unattractive. As a suggestion, could the staples come right through these pages? It might help.

What do you think? You don't have to answer that one if it does not merit it, but I do think it just spoils what otherwise is a jolly useful publication.

H. WILLIAMSON

Refinery Maintenance Engr.
Trinidad Oil Co. Ltd.
Pointe-a-Pierre, Trinidad, B.W.I.

● *We're considering just this. Are other readers in the same boat?*

Back-to-back

TO THE EDITOR: I believe in clipping articles from your magazine for filing. It's quite discouraging to find two articles I want back-to-back, the last page of one printed on the same sheet of paper as the first page of the next. This could be easily avoided by starting all articles on odd-numbered pages and ending them on even pages.
pages.

W. L. SKAGGS

The Lummus Co.
Houston, Texas

● *Our less drastic solution is to send extra copies of such pages on request.*

Gray to Pure

TO THE EDITOR: On page 83 of the August 1956 issue of PETROLEUM PROCESSING ["Sulfur in Gasoline . . . an Economic Appraisal"], the item relating to "Gray Process" states that this process is licensed by the Gray Processes Corp., Jersey City, N. J.

The Gray Processes Corp. was dissolved in December of 1952 and all its remaining patents were assigned to The Pure Oil Co.

EDWARD H. LANG

Patent Counsel
The Pure Oil Co.
Chicago, Ill.

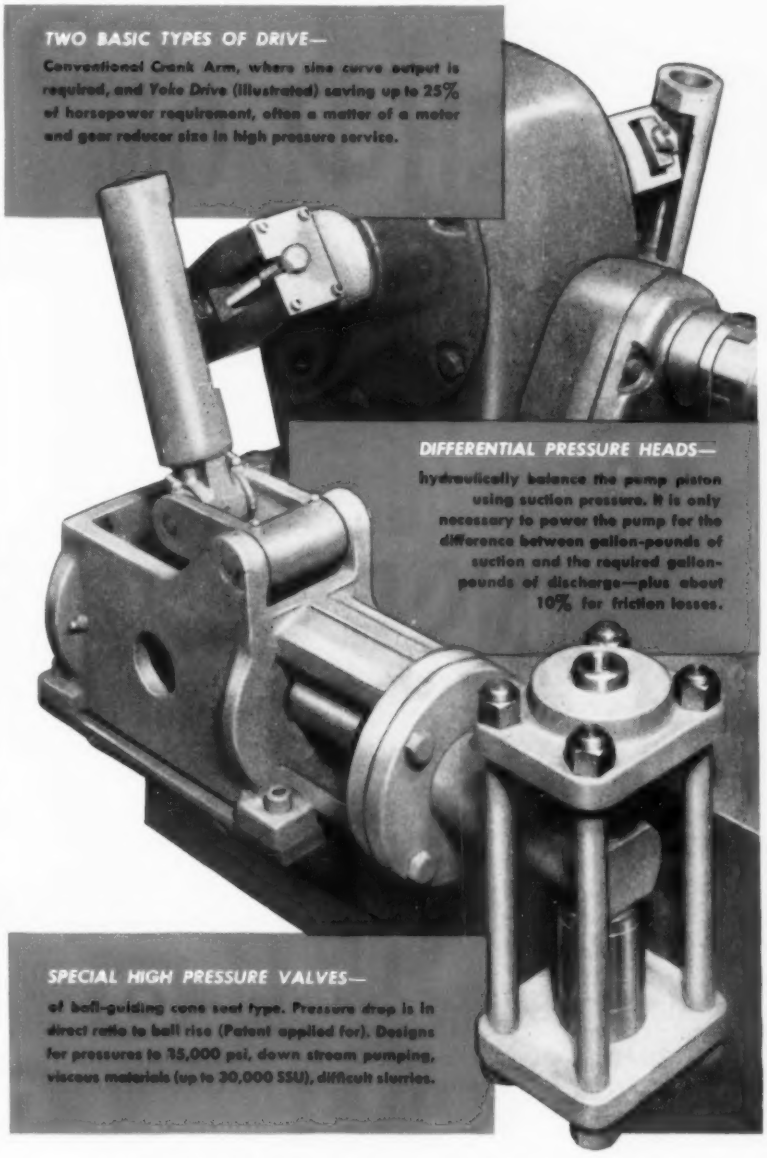
You missed us!

TO THE EDITOR: The article on asphalt blending in the January issue of PETROLEUM PROCESSING ["Surge Ahead for Asphalt" pp. 39-44] contained a good explanation of the method of continuous asphalt blending that our company has pioneered. We were glad to assist you in its preparation.

However, we regret that there was no mention of Proportioneers—even under the drawing you used of our type of integrated blending system. Although Proportioneers' blending systems are already well known throughout the petroleum processing

PHILADELPHIA PUMPS
SERIES HP • HIGH PRESSURE

Advanced Designs—for economy, safety and performance—demanded by modern high pressure processing techniques. Examples: flow-blending chemicals and inhibitors, pulsing liquid extraction of metals, pumping liquid gases, metering D_2O to homogeneous reactors, charging pressurized-water atomic power systems, etc.


TWO BASIC TYPES OF DRIVE—
Conventional Crank Arm, where sine curve output is required, and Yoke Drive (illustrated) saving up to 25% of horsepower requirement, often a matter of a motor and gear reducer size in high pressure service.
DIFFERENTIAL PRESSURE HEADS—
hydraulically balance the pump piston using suction pressure. It is only necessary to power the pump for the difference between gallon-pounds of suction and the required gallon-pounds of discharge—plus about 10% for friction losses.
SPECIAL HIGH PRESSURE VALVES—
of ball-guiding cone seat type. Pressure drop is in direct ratio to ball rise (Patent applied for). Designs for pressures to 15,000 psi, down stream pumping, viscous materials (up to 30,000 SSU), difficult slurries.

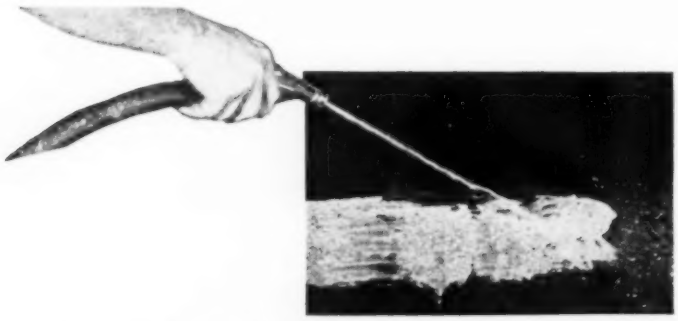
CATALOG HP-1254 describes these *advanced designs.*

PHILADELPHIA PUMP & MACHINERY COMPANY
13500 Philmont Avenue, Philadelphia 16, Pa.
SUBSIDIARY, AMERICAN METER COMPANY

(To obtain more data on advertised products see page 170)

Amazing new stripper for removing paint!

BRUSH IT ON



RINSE IT OFF

Take a stop watch in one hand and a brush full of Oakite Composition No. 57 in the other and see for yourself how this amazing new paint stripper goes to work in seconds ... practically lifting the paint behind the brush.

See how Oakite Composition No. 57, paint stripper extraordinary, clings to vertical and inverted surfaces, eliminating costly waste. How easily loosened paint rinses away with water pressure spray.

Oakite Composition No. 57 is tops for removing those tough alkaline resistant paints from surfaces that just can't be dip-stripped. Get the full story today by writing for Special Report B–2415 and the Paint Stripping Handbook F–7893. Both FREE..

SPECIALIZED INDUSTRIAL CLEANING
OAKITE
MATERIALS · METHODS · SERVICE
SCIENCE

Export Division
Cable Address: Oakite

Technical Service Representatives in Principal Cities of U. S. and Canada

field, we still appreciate published identification of our equipment, as pictured on p. 42 of your January issue.

LAWRENCE LOWY
Regional Engineer
Proportioneers, Inc.
New York 7, N. Y.

● *Much of the data for this asphalt blending article was provided by Mr. Lowy, and* PETROLEUM PROCESSING *sincerely regrets the unintentional omission of proper credit*—Editor.

Alloy or not alloy

TO THE EDITOR: As a recent subscriber to your magazine, the first item I came across in perusing my first copy revealed the following inaccuracy:

Pipe, steel, carbon, seamless, Grade B, Specification A-106 is referred to in Table 2 on p. 55 of your December, 1956, issue [Choosing Metals for the Refinery"] as "this alloy." The aforementioned specification of the ASTM only covers seamless, carbon steel pipe. Therefore, the term "alloy" is not applicable in this instance.

R. CARLETON SIMON
Montreal, Que.

● *Webster defines an alloy as a "substance composed of two or more metals, or by extension, of a metal and a nonmetal intimately united, usually by being fused together and dissolved in each other when molten."*

So carbon steel is technically an alloy—of iron and carbon—common usage notwithstanding.—Editor.

That printer's devil

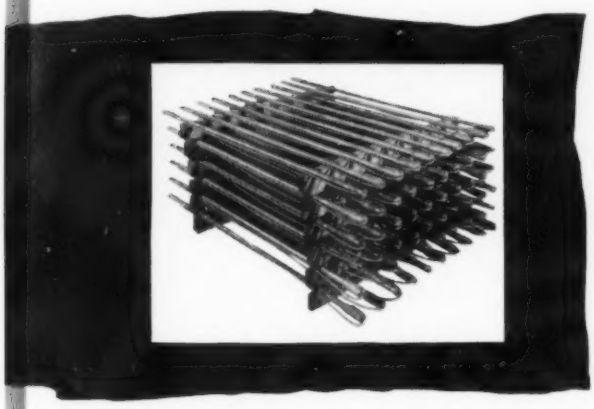
TO THE EDITOR: We would like to call your attention to an error in the listing of our company in your 1956 Petrochemical Plant Directory (Sept., 1956, p. 126). Our company name is "Petrocarbon Chemicals, Inc.," not "Petrochemicals, Inc."

J. M. BAGGS
Petrocarbon Chemicals, Inc.
Irving, Texas

● *Thank you, Reader Baggs. We checked our records and found the name of your firm appeared in proper spelling at every stage in the production, yet appeared incorrect in the final bound copies of our September issue. Our apologies for any inconvenience this unexplainable error may have caused.*

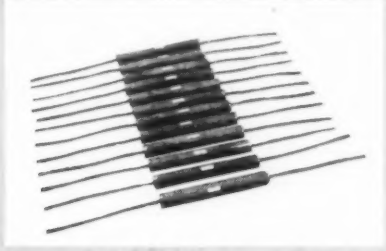
(To obtain more data on advertised products see page 170)

When Duriron was first introduced as a cathodic protection medium, performance data reported was necessarily that of simulated field conditions in the laboratory. Now, with installations numbering more than 15,000 anodes, we can report qualitatively on Duriron in various ground bed, fresh water or salt water conditions.



Qualitative reports now available on DURIRON® in cathodic protection service

Many of these reports are available now. More are currently in preparation for early release. If you feel that your present method of protection could be improved, we urge you to let us send you these reports as they become available. They more than confirm our reports of laboratory results!



THE DURIRON COMPANY, INC.
Dayton, Ohio

DURIRON® anodes

The Duriron Company, Inc., Dayton, Ohio, Dept PP

PLEASE SEND REPORTS ON DURIRON ANODE INSTALLATIONS.

Name_____ Title_____ Company_____

Address_____ City_____ State_____

AT YOUR FINGER TIP.

FISHER GIVES YOU "ON-THE-SPOT" SERVICE WITH...

3	22	53	203
FACTORIES	FIELD STOCKS	SALES OFFICES	SERVICE ENGINEERS

FISHER® SERVICE

You, personally, are "right next door" to an alert source of supply of Fisher control valves, gas regulators, liquid level controllers and pressure regulators.

Whether your problem is one of existing equipment—or an entirely new control application—the Fisher country-wide network of 3 factories, 22 strategically located field stocks and 53 representatives, with 203 Fisher Service Engineers—offers you convenient service on all your control requirements.

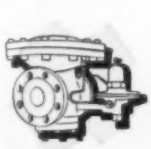
FISHER GOVERNOR COMPANY

Marshalltown, Iowa — *Woodstock, Ontario*

World Leader In Research for Better Pressure and Liquid Level Control

FISHER SERVICE DIRECTORY

ALBANY
Crabbe & Stebbins Co.
AMARILLO
Vinson Supply Co.
ATLANTA
Jack M. Smither & Co.
BALTIMORE
Rhodes Controls Co.
BIRMINGHAM
Jos. W. Eshelman & Co.
BOSTON (NEEDHAM)
C. B. Petty & Co.
BUFFALO
W. J. Sommers Co., Inc.
CALGARY
Barber Engineering & Supply Co.
CHARLOTTE
Robert E. Mason & Co.
CHICAGO
General Meters & Controls Co.
CINCINNATI
Harry T. Porter Co.
CLEVELAND
A. E. Ehrke & Co.
COLUMBUS
A. E. Ehrke & Co.
CORPUS CHRISTI
Puffer-Sweiven Co.
DALLAS
Vinson Supply Co.
DENVER
Joy & Cox, Inc.
DETROIT
DuBois-Webb Co.
FARMINGTON
Vinson Supply Co.
GRAND RAPIDS
DuBois-Webb Co.
HOUSTON
Puffer-Sweiven Co.
INDIANAPOLIS
Acme Engineering Agency
KANSAS CITY
Sullivan-Mears Co.
LITTLE ROCK
Johnson & Scott
LOS ANGELES
Carter-Jones Co.
LOUISVILLE
Allan K. Cook Co.
MARSHALLTOWN
R. S. Stover Co.
MEMPHIS
Johnson & Scott
MEXICO CITY
Babcock & Wilcox de Mexico, S. A.
MILWAUKEE
Warren D. Ehrke & Co.
MINNEAPOLIS (HOPKINS)
J. F. Schultz & Co.
MONTREAL
Process & Steam Specialties, Inc.
NASHVILLE
Johnson & Scott
NEW ORLEANS
John H. Carter Co.
NEW YORK (ENGLEWOOD CLIFFS, N. J.)
Crabbe & Stebbins Co.
ODESSA
Vinson Supply Co.
OKLAHOMA CITY
Vinson Supply Co.
PHILADELPHIA (NARBERTH)
C. B. Ives & Co., Inc.
PHOENIX
Cone & Wallace Co.
PITTSBURGH
J. G. Chilcoat & Co.
PORTLAND
R. H. Brown & Co.
RICHMOND
W. H. Kidd & Co.
SALT LAKE CITY
Williams, Gritton & Wilde
SAN FRANCISCO
George R. Friederich & Co.
SEATTLE
Barrett & Yost
SHREVEPORT
John H. Carter Co.
SOUTH EDMONTON
Barber Engineering & Supply Co.
ST. LOUIS
H. D. Hale & Co.
TORONTO
G. W. Beecroft Co., Ltd.
TULSA
Vinson Supply Co.
VANCOUVER
Northern Columbia Process Equip., Ltd.
WICHITA
Sullivan-Mears Company
WINNIPEG
Mechanical Valve & Engineering Specialties
WOODSTOCK
Fisher Governor Co.


PRESSURE REGULATORS

GAS REGULATORS

LIQUID LEVEL CONTROLLERS

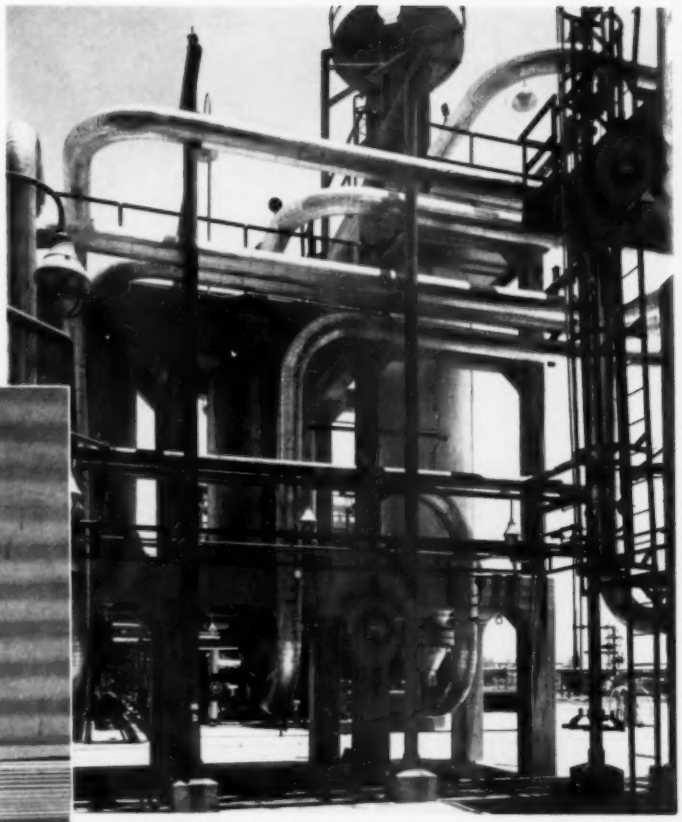
DIAPHRAGM CONTROL VALVES

PUMP GOVERNORS

LEVER AND FLOAT VALVES

CHILDERS JACKETING

Protects Your Insulation Investment



EASILY INSTALLED with only a screwdriver and a wedge. Inexpensive strapping holds Childers Jacketing securely, yet permits easy removal for inspection of the lines. Same jacketing can then be reapplied without waste.

...safeguards insulation on process lines in thousands of refineries and chemical plants

It's a fact that you benefit from world-wide experience when you protect costly insulation on lines, towers, vessels and tanks with Childers Aluminum Jacketing. More than 2,000 petroleum refining, petrochemical and chemical plants endorse your decision to use Childers Jacketing.

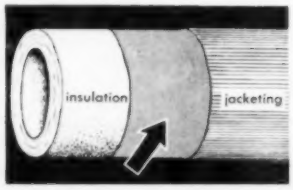
Childers' experience in protecting insulation has provided the most complete line of permanent-type weatherproofing offered today. Five weights of aluminum are available. In addition, time-saving Lap Seal (patent pending), factory-attached moisture barrier and rolled-in cross-corrugation give superior protection and reduce costs.

The initial cost is lower for Childers Jacketing than any other permanent weatherproofing... even lower than some temporary coverings. But the biggest savings are in the maintenance-free years following installation. Costly insulation is effectively protected against weather damage and physical abuse.

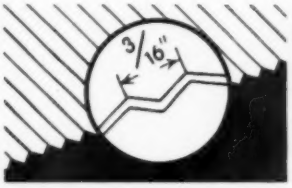
Improved appearance of your plant and easier "housekeeping" are "plus" benefits of Childers Aluminum Jacketing.

Childers Engineering Representatives give professional advice on insulation jacketing in all major industrial centers. Send for a **free sample** of jacketing, engineering data on how to safeguard your insulation and the name of the Childers Engineering Representative near you. Write Childers Manufacturing Co., Dept. PP-9, P. O. Box 7467, Houston 8, Texas.

LAP SEAL, available at no extra cost, is a series of 8 ribs rolled into the underlapping edge of the jacketing, providing an automatic measure of the 2" circumferential lap. Proper lap is insured without waste. Labor is saved. Where desired, a positive weather seal is easily made with Lap Seal and a mastic.



FACTORY-ATTACHED MOISTURE BARRIER protects the underside of aluminum from possible attack by alkaline solutions present in most insulating materials. The moisture barrier, bonded at the factory by continuous strip adhesive, adds little to cost, saves application labor, insures against underneath corrosion.



TESTS PROVE EXTRA STRENGTH of rolled-in 3/16" cross corrugation. Vertical strength and rigidity of a .016" sheet with this 3/16" cross corrugation are increased to that of a plain .024" sheet. Jacketing costs are consequently reduced by as much as 1/3 when Childers Jacketing is used instead of ordinary sheet aluminum.

DEEP CORRUGATED Childers Jacketing in 1¼" and 2½" corrugations is recommended for permanent protection and improved appearance of insulated towers, vessels and tanks. Deep Corrugated Jacketing with factory-attached moisture barrier is another product available only from Childers.

Another Giant by Delta

This Butane Splitter fabricated for another of Delta's growing list of petro-chemical majors, is 125′ 0″ in length. It weighs 257,722 pounds and was shipped in one section. Another example of the engineering and fabricating experience available at Delta.

DELTA TANK MANUFACTURING COMPANY, INC.

BATON ROUGE, LOUISIANA

PLANTS: BATON ROUGE, LA. • MACON, GA. • BEARDSTOWN, ILL.
EXPORT OFFICE: INTERNATIONAL TRADE MART, NEW ORLEANS, LA.
SALES OFFICES: NEW YORK, N. Y. • WESTWEGO, LA. • LAFAYETTE, LA.
BOSSIER CITY, LA. • LAUREL, MISS. • HOUSTON, TEXAS

(To obtain more data on advertised products see page 170)

Out of our working partnership with refiners

Aerocat® BALANCED

(To obtain more data on advertised products see page 170)

D PERFORMANCE CATALYSTS

prove again and again it's results that count!

OPERATING REFINERS AID CYANAMID IN DESIGNING SUPERIOR CATALYSTS

Now you can get the highest efficiency yet in fluid catalytic cracking! Cyanamid has enlarged and improved its manufacturing facilities for regular and high-alumina AEROCAT Catalysts as a result of technical advances in catalyst manufacture developed at its Stamford, Connecticut Research Center.

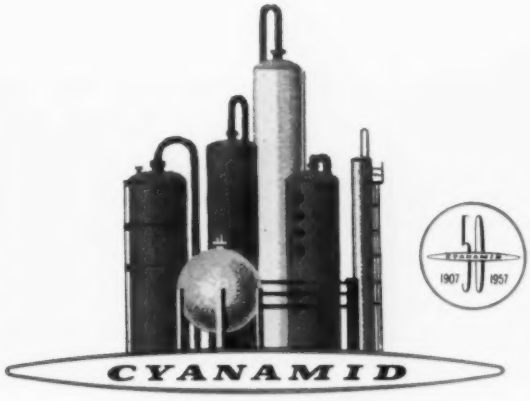
Refiners have long recognized that no one factor dominates in catalyst performance. Cyanamid's consistent objective has been to bring every variable in catalyst properties into balance for peak performance under varying refinery operating conditions. Our development work has always been based on operating and research data provided directly by refiners . . . a cooperation which has paid large dividends in cracking efficiency.

New equipment developed by Stamford Research contributes to a unique manufacturing process, governed at every production stage by rigid laboratory-checked controls. This enables us to maintain commercial production at research quality standards.

Your evaluation of the new AEROCAT Catalysts is invited. Our technical service and research staffs will do their best to help you get on stream to greater productivity.

Unique vapor phase chromatography apparatus developed by our Stamford Research Center automatically identifies volatile organic liquids. Apparatus permits rapid evaluation of catalyst efficiency at the refinery or under laboratory conditions. It is typical of the highly specialized equipment used at Stamford for catalyst research.

Again, it's *results* that count—and the relative importance of *all* catalyst properties has been under exhaustive research in laboratories of Cyanamid and its customers. In this way, AEROCAT Catalysts have been improved to give refiners highest cracking efficiency.



AMERICAN CYANAMID COMPANY
REFINERY CHEMICALS DEPARTMENT
30 Rockefeller Plaza, New York 20, N. Y.

In Canada: North American Cyanamid Limited, Toronto and Montreal

(To obtain more data on advertised products see page 170)

Here's Why Oil Men Specify—

EC&M
HIGH VOLTAGE STARTERS

2200-4800 VOLTS
FOR
PRESSURIZED ROOMS
OUTDOORS
INDOORS

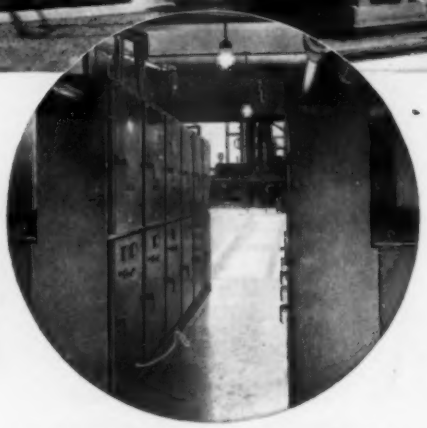
left • Type AH Starter (50,000 KVA, certified) for Division 2 Applications. NEMA 3R (raintight) Enclosures for mounting outdoors
below • Diesel loading pump station in southwestern refinery

EC&M Starters are standardized for *easy selection.* They are *easier to install* because they are shipped with all internal wiring complete. They are designed for *easier, faster inspection and maintenance.* And—they *save valuable space* because they are compact with no sacrifice in accessibility.

EC&M's Type AH Starters are available in NEMA 1 or 3R (raintight) enclosures for outdoors, indoors or pressurized control rooms. Three interrupting ratings: 50,000 KVA—POWER FUSED—and VALIMITOR®

***Write* for Bulletin 8131-C**

Five EC&M Aligning Starters with Incoming Line and Feeder Panels for Pumps and Compressors (Pacific Coast Refinery)



Pressurized Control Room with ten NEMA 1 EC&M Enclosed Starters in midwest refinery

THE ELECTRIC CONTROLLER & MFG. CO.
A DIVISION OF THE SQUARE D COMPANY
CLEVELAND 28 • OHIO

8019

DU PONT *Petroleum Chemicals* NEWS

One of a Series of Bulletins for the Petroleum Industry

MARCH 1957

Locomotive maintenance men report longer bearing life with fewer greasings

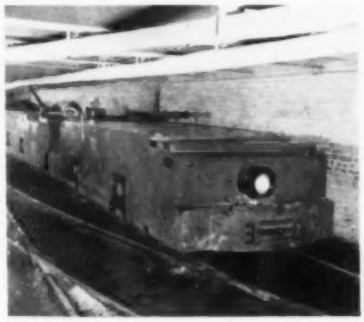
After switching to a grease based on Du Pont Estersil GT (grease thickener), one company substantially reduced bearing maintenance and replacement costs.

Running almost continuously, the company's 22 locomotives many times a day haul heavy cars from mine to surface. They operate in tandem to pull 210-ton loads seven miles up a 3% grade.

Bearing maintenance reduced

Under such rugged service, the temperature of the four armature bearings in each locomotive rises as high as 300°F. Before an estersil-based grease was used, the bearings were greased every month. Now with estersil grease, the job is done only every *two* months.

The company's mechanics report important savings on bearing replacement as well. They point to the company's previous average of one bearing replacement every two weeks. Since estersil-based grease has been used (six months), not a single bearing replacement has been necessary.



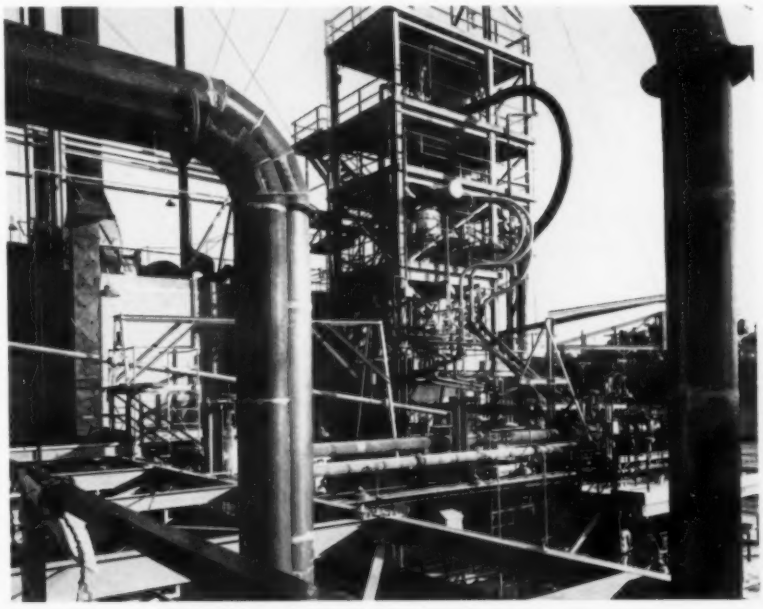
This compact locomotive operates under the toughest conditions. The grease packed into its armature bearings must have special properties to withstand the dust, high shear, and hot bearing temperatures.

The unique qualities of Du Pont Estersil GT are behind such dependable service. Estersil greases show outstanding resistance to mechanical breakdown and are practically immune to water, extreme heat and extreme cold.

A Du Pont Petroleum Chemicals Division representative will be glad to give you more detailed information about estersil GT and to provide samples. Contact any of our sales offices.

New Du Pont West Coast TEL plant now in production

The new tetraethyl lead plant constructed by Du Pont at Antioch, California, is now on stream. This will make possible extra-fast deliveries of California-made TEL to all West Coast refiners.



Top of TEL pipe alley looking toward reactor tower.

The new plant is located approximately two miles east of Antioch on the San Joaquin River.

Integrated facilities

The new plant was built to meet the needs of the fast-growing West Coast oil industry. The present Du Pont Petroleum Chemicals Division regional laboratory at El Monte, and sales offices in Los Angeles, San Francisco and Seattle, together with the new plant, will provide complete service for TEL-users on the West Coast.

Plant most modern in the world

The new Du Pont plant has the most modern TEL manufacturing facilities in the world, incorporating in its design and equipment the latest continuous processing advances and many other production refinements.

ADVERTISEMENT—Prepared for the Petroleum Chemicals Division of E. I. du Pont de Nemours & Company (Inc.)

OVER

DU PONT *Petroleum Chemicals* NEWS

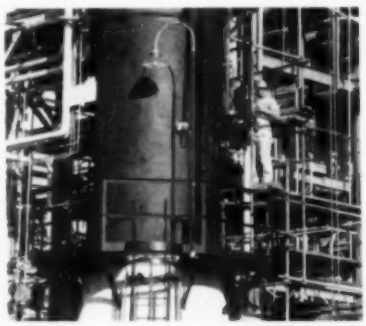
CONTINUED

New TEL Plant

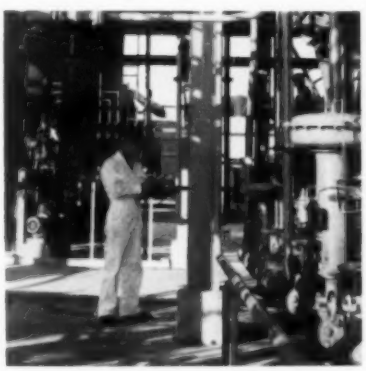
Another new Du Pont plant for making "Freon"* refrigerants and propellants is also located at Antioch. The "Freon" facilities were completed and production was started last fall.

Du Pont becomes a larger West Coast customer

The two Du Pont plants at Antioch have become important new customers for large volumes of materials produced locally. Du Pont employees at Antioch already number 325; they were recruited locally.



Base of ethyl chloride column, TEL area.



Operator logging data in TEL area.

TEL central control room.

THESE MEN HEAD NEW ANTIOCH TEL PLANT

HENRY L. GREENE

DONALD C. MILLER

Top management posts at our new Antioch plant have been filled by Henry L. Greene and Donald C. Miller. Mr. Greene is plant manager and Mr. Miller assistant plant manager of the combined new TEL and "Freon"* refrigerant and propellant plants.

Mr. Greene joined the Du Pont Company in 1934 as a senior engineer. He advanced to supervisory posts at the Chambers Works, in New Jersey, then moved to Du Pont's neoprene plant at Louisville, where in 1946 he became assistant manager. In 1952 he was appointed assistant manager of the Savannah River Plant. He is a chemical engineer, a graduate of Kansas State College.

Mr. Miller came with Du Pont in 1937 as an analyst at Jackson Laboratory, Chambers Works. Following assignments in several other plants, he returned to the Chambers Works in 1943, where he became senior supervisor in TEL production. When in 1951 he was awarded the position of assistant works engineer, he was one of the youngest men ever to fill the job.

Mr. Miller received his B.S. in chemical engineering from Ohio State University.

**Registered Du Pont trademark.*

LITERATURE AVAILABLE

A handy check list for anyone planning dealer meeting programs.

Here is a partial listing of the many bulletins, reports, booklets, technical papers, and other aids available to you through any of the Du Pont Petroleum Chemicals Division offices:

Du Pont Estersil GT—A brief description of the properties, composition and applications of estersil grease thickener. Explains estersil grease preparation and contains handling information.

New Du Pont Dry-dye Eduction Probe and No-dust Drumhead—A folder describing and illustrating the revolutionary new dry-dye eduction devices, which make gasoline dyeing a cleaner, faster, and more efficient operation.

Sales Promotional Aids for Dealer Meetings—Describes the many Du Pont aids available for dealer meetings.

SALES OFFICES

Chicago 3–8 So. Michigan Ave. RAndolph 6-8630
Cleveland 15–25 Prospect Ave. SUperior 1-1363
Houston 2–705 Bank of Commerce Bldg. CApitol 5-1151
Los Angeles 17–612 So. Flower St. MAdison 5-1691
New York 20–1270 Ave. of the Americas COlumbus 5-2342
Philadelphia 2–3 Penn Center Plaza LOcust 8-3531
Pittsburgh 22–1 Gateway Center ATlantic 1-2933
San Francisco 4–111 Sutter St. EXbrook 2-6230
Seattle 3–4003 Aurora Ave. MElrose 6977
Tulsa 1–1811 So. Baltimore Ave. LUther 5-5578
In Canada–Du Pont Company of Canada (1956) Limited, Petroleum Chemicals, 85 Eglinton Ave. East, **Toronto 12**–Ontario HUdson 1-6461
In Other Countries–Petroleum Chemicals Division, Export Sales, 7496 Nemours Bldg., Wilmington 98, Del., OLympia 4-5121, Ext. 2962

DU PONT
REG. U.S. PAT. OFF.

Better Things for Better Living
. . . through Chemistry

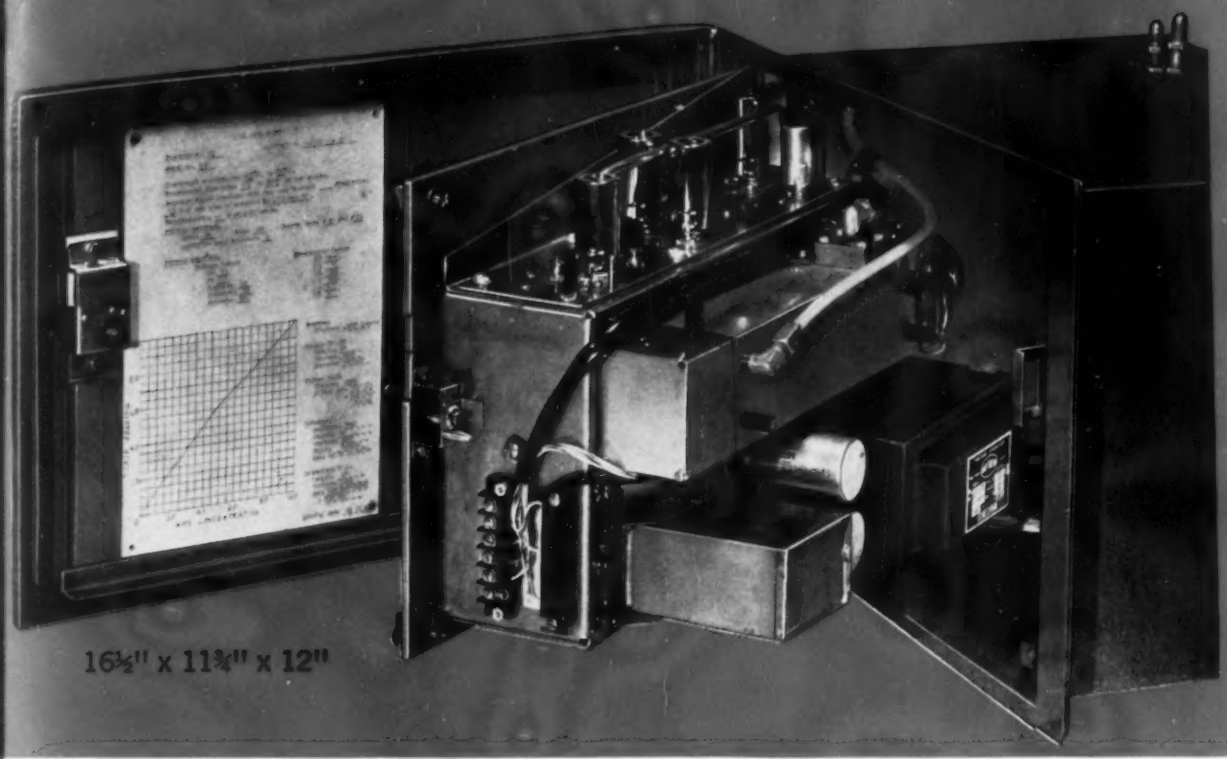
OVER

ADVERTISEMENT—Prepared for the Petroleum Chemicals Division of E. I. du Pont de Nemours & Company (Inc.)

A-3638

Printed in U. S. A.

LOW-COST INFRARED ANALYZER FOR PROCESS STREAM CONTROL



New M-S-A® LIRA Model 200 features unitized construction for easy operation

This deflection type infrared analyzer provides automatic, continuous, high-speed, accurate analysis for a single component in a simple or complex mixture of gases or liquids. Ideal for process measurement and control, quality control, and the measurement of toxic and combustible gases or vapors in ranges from a few parts per million to 100% of gas.

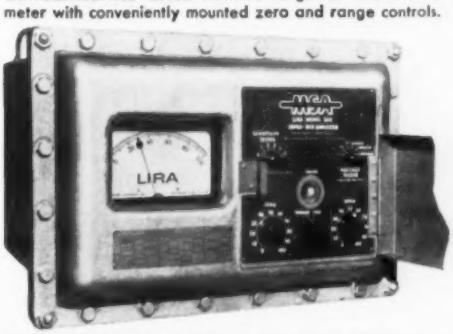
Completely self-contained, the Model 200 includes facilities for electrically checking the performance of each part of the system. Speed of response is 90% of final reading in 5 seconds. Noise level is less than 1% of full scale. Zero drift is less than 1% of full scale in 24 hours. Accuracy is ±1% of full scale. Warm-up time is 30 minutes.

Service and maintenance are quick and easy on the new M-S-A LIRA Analyzer Model 200, thanks to design simplicity and small compact size. Unitized construction places amplifier, optical bench power supply and zero calibration controls all in readily accessible units on a single swing-out chassis.

Also available is the Model 100 incorporating the Null Balance principle for extreme sensitivity, stability and selectivity.

If you're looking for improved product quality, lower processing costs, or increased safety in your operation, write for new M-S-A LIRA booklet for more detailed information.

CONVENTIONAL CASE contains large 6" illuminated meter with conveniently mounted zero and range controls.



EXPLOSION-PROOF CASE is slightly larger than conventional case and has tamper-proof lock. All controls are easily accessible through the explosion-proof enclosure.

INSTRUMENT DIVISION

MSA

MINE SAFETY APPLIANCES COMPANY

Pittsburgh 8, Pennsylvania

At your Service: 76 Branch Offices in the United States

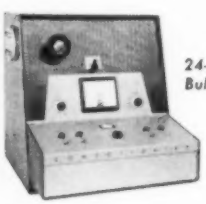
Recognized leaders in analysis

38-202 Process Refractometer
Bulletin CEC 1833-X3

The science of qualitative and quantitative analysis by mass spectrometry was pioneered and developed by Consolidated Electrodynamics Corporation. CEC's 21-103C Mass Spectrometer analyzes complex mixtures at unequalled speed and accuracy. Its extreme sensitivity (1/1000 mol per cent) plus wide range (from mass 2 to mass 700) offers maximum versatility. The compact 21-620, utilizing the "Cycloidal Focusing" principle, is ideal for accurate readings from mass 2 to mass 150. CEC's mass-spectrometer-type leak detectors find use in hundreds of industrial applications. The 24-110 Leak Detector registers trace quantities of helium as small as one part in two million parts of air, and the low-cost portable 24-210 detects one part of helium in 300,000 parts of air.

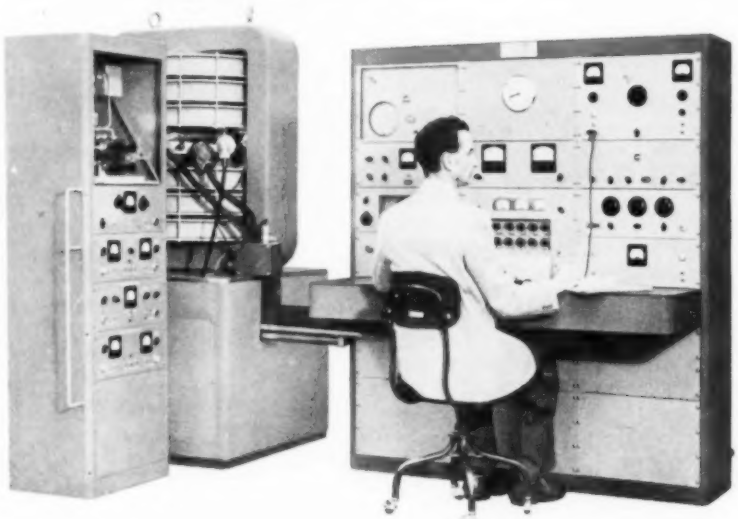
CEC's vapor-phase Chromatograph provides fast, accurate analysis of almost any mixture, including liquids with boiling points as high as 325° C. Its exclusive *heated* sampling valve gives superior reproducibility by eliminating both operator error and sample contamination. For sulfur-compound detection, CEC's Titrilogs are highly sensitive, offer a wide range and instantaneous response. Both the stationary and portable models report sulfur-compound concentrations as low as 0.1 ppm or 0.005 grains per 100 cubic feet.

24-110 Leak Detector
Bulletin CEC 1838-X7



24-210 Leak Detector
Bulletin CEC 1830-X15

26-103 Titrilog
Bulletin CEC 1810-X11



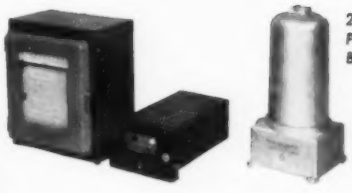
21-620 Mass Spectrometer
Bulletin CEC 1824-X10

21-103C Mass Spectrometer
Bulletin CEC 1800-X24

(To obtain more data on advertised products see page 170)

...and process control

26-201 Chromatograph
Bulletin CEC 1831-X14



26-202
Process Chromatograph
Bulletin CEC 1836-X3

Custom engineered for the petroleum and chemical industries, the Consolidated-Philips Process Refractometer measures the difference between a liquid standard and a liquid sample from a process line. This explosion-proof, dependable unit quickly pays for itself through increased product yield and product quality. CEC's *new* Moisture Monitor gives accurate measurements down to one part per million of moisture present in gaseous mixtures. Equipped with an adjustable and accurate flow regulator and a meter calibrated in ppm, the 26-301 permits precise readings from 0 to 1000 ppm by means of a 5-step attenuator.

26-301 Moisture Monitor
Bulletin CEC 1834-X10

For complete information—applications, specifications and features—please write for the specific Bulletins listed in this advertisement . . . or contact your nearby CEC field office. Your best investment for product improvement is a Consolidated instrument.

Consolidated

. . . leading manufacturer of electronic instrumentation and high-vacuum equipment

ELECTRONIC INSTRUMENTS
Recording Oscillographs
Galvanometers
Direct-Writing Oscillographs
Oscillogram Processors
Magnetic Tape Equipment
Analog-to-Digital Converters
Data-Processing Systems
Data Amplifiers
Power Supplies
Vibration Meters
Vibration Pickups
HYGE Shock Testers
Pressure Pickups
Electromanometers
Mass Spectrometers
Gas Chromatographs
Process Refractometers
Oxygen Analyzers
Ultraviolet Analyzers
Titrilog Sulfur Recorders
Leak Detectors

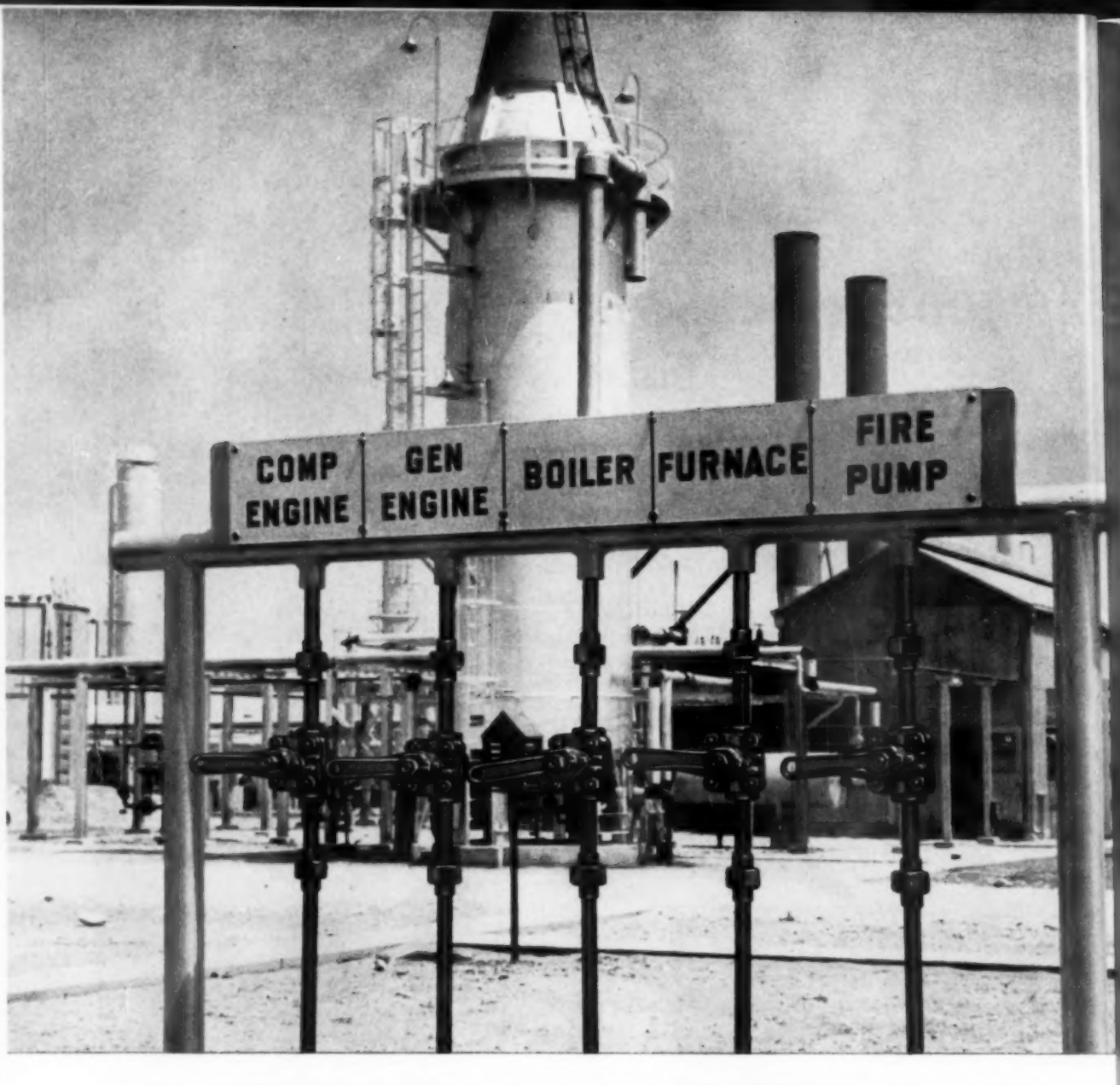
HIGH-VACUUM EQUIPMENT
Furnaces
Metalizers
Stills
Pumps
Valves & Gauges
High-Vacuum Systems

SERVICES
Analytical Service
Application Engineering
Research & Development
Systems Engineering

Consolidated Electrodynamics

300 North Sierra Madre Villa, Pasadena, California

NATIONWIDE COMPANY-OWNED SALES & SERVICE OFFICES



THE LITTLE VALVES WITH THE BIG JOB

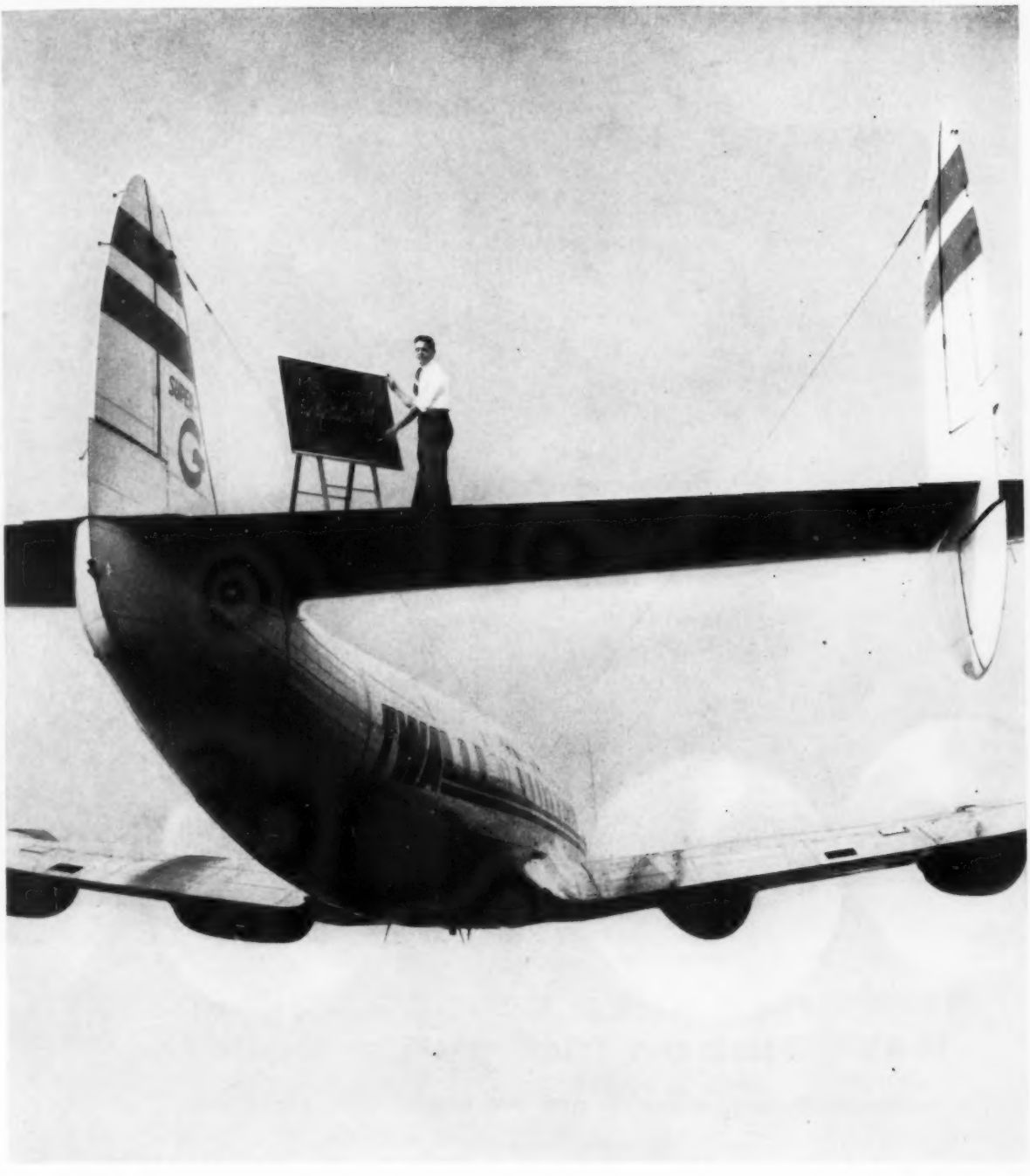
The Rockwell-Nordstrom valves on the emergency shut-off manifold above have a really big job. On their absolute dependability rests millions of dollars of capital investment.

Why do you so often see Rockwell-Nordstrom lubricated plug valves in the really vital spots? The answer: users know they provide *both* essentials of a truly dependable valve. They won't stick or gall—pressurized lubricant readies the plug for *instant, quarter-turn operation*. And, equally important, they assure *positive shut-off*.

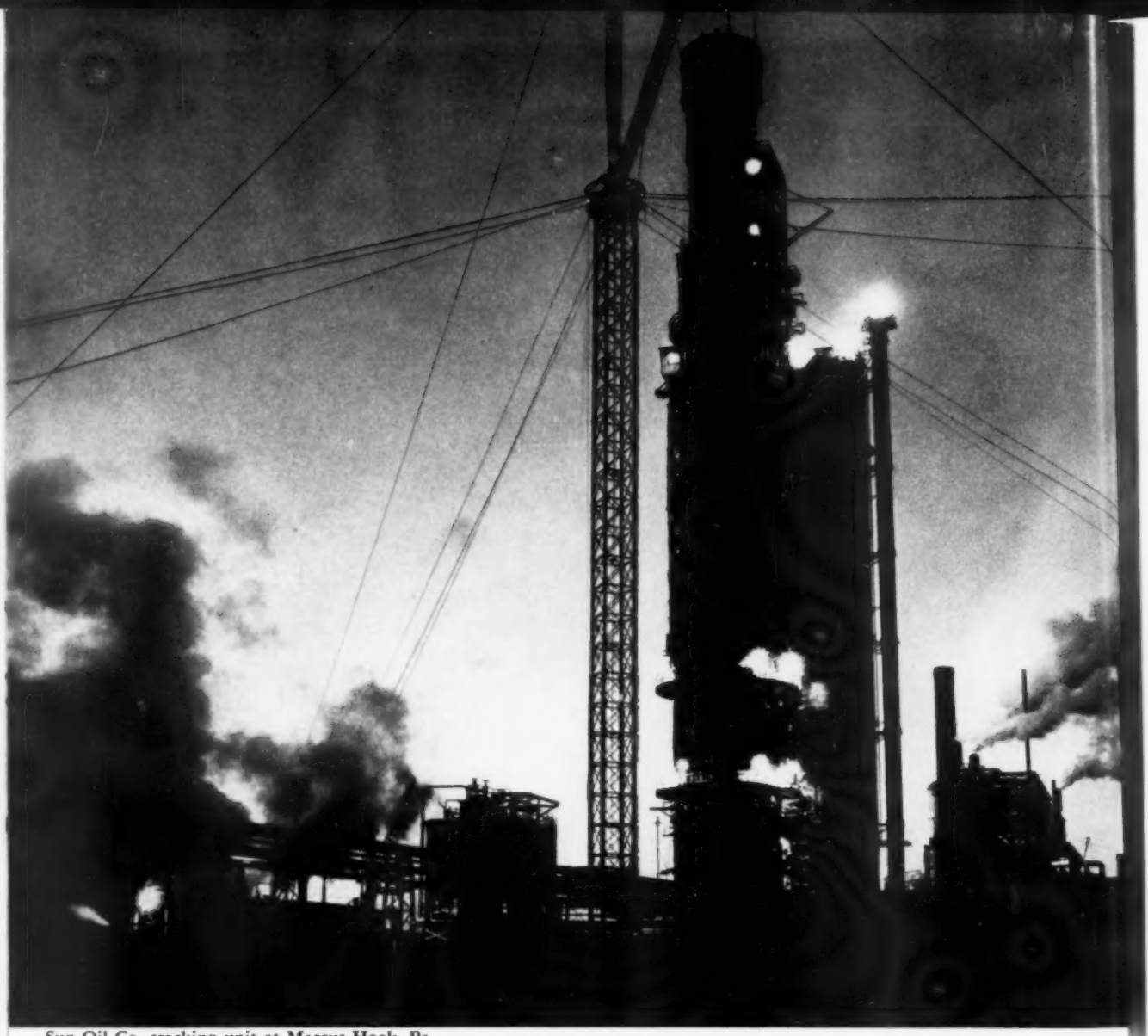
These same important advantages—instant operation and positive shut-off—also make Rockwell-Nordstrom valves your best investment for practically every flow control need. And they cost no more to buy, often less, than ordinary valves. For complete details, call your supplier or write Rockwell Manufacturing Company, Pittsburgh 8, Pa. *Canadian Valve Licensee:* Peacock Brothers Limited.

ROCKWELL-Nordstrom VALVES

Lubricant Sealed For Positive Shut-off



Oilmen should be up in the air! An oil company physicist and his slate of equations may seem out of place in the sky. But airmen couldn't get off the ground without oilmen. Oil helped fly 50 million passengers on U. S. air lines last year. And oil company researchers are developing jet and rocket fuels that will shrink tomorrow's world even more. Remember these things when you hear misinformed people speak against your industry. Speak up—tell how you help give America wings! **SHELL OIL COMPANY** SHELL



Sun Oil Co. cracking unit at Marcus Hook, Pa.

Refineries Save $3,500,000 with B&W Carbon Monoxide Boilers

Users Report Boilers Are Paying For Themselves

B&W Carbon Monoxide Boilers, in oil refineries, are compiling outstanding records. The seven units already on stream have produced, since 1953, savings of $3,500,000 in fuel costs. And every day they are in operation, they continue to save money. Each of these boilers is quickly paying for itself. No wonder a total of 15 units has been ordered to date.

Big fuel savings are achieved because B&W "CO" Boilers put sensible and combustible heat to work. In extended, sustained service they have proved their efficiency, reliability, and economy.

The cracking unit becomes independent of other steam sources. The boiler can be operated at all times, whether or not the cracking unit is on stream.

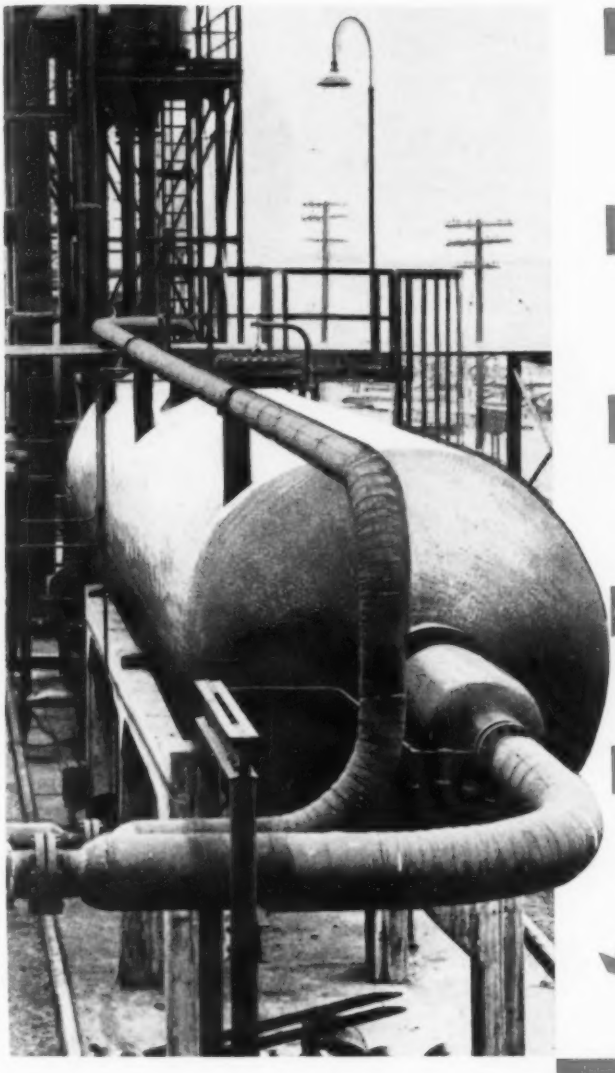
B&W engineers, experienced in meeting differing refinery conditions, can design a B&W "CO" Boiler to fit your specific requirements, for any steam pressure and temperature, for any size cracking unit. The Babcock & Wilcox Company, Boiler Division, Dept. PP-2, 161 East 42nd Street, New York 17, N. Y.

G-832-CO

BABCOCK & WILCOX

BOILER DIVISION

5 REASONS WHY
TRETOLITE all-chemical DESALTERS
are in use wherever oil is refined



1 **95 to 100% SALT REMOVAL**—The highest standards of purification possible in commercial operation. In addition to a 95 to 100% range salt removal, Tretolite Desalters also remove other solids, fines and trace metals from the crude charge.

2 **AVERAGE CHEMICAL COST OF $.0013 PER BARREL**—A real economy of operation that is consistent . . . about 1.3 mills per barrel. Water usage is also minimal, and only the pumps require power.

3 **THE ORIGINAL ALL-CHEMICAL DESALTING PROCESS**—Tretolite originated all-chemical desalting, and was the *first organization* to provide a desalting system for refiners. The result is a desalting experience unequalled in this field.

4 **PERFORMANCE-PROVED EVERY DAY BY 1½ MILLION BARRELS**—Wherever you see refining, you're sure to see Tretolite Desalters.

5 **AUTOMATIC OPERATION**—The epitome of simplicity—requires only minimum operating attention. If you have a desalting problem . . .

Ask the Man in the Red Car

The Tretolite Service Engineer is always on call to assist you in any of your maintenance and processing problems.

Chemicals and Services for the Petroleum Industry

DESALTING • DEMULSIFYING • CORROSION INHIBITING
SCALE PREVENTING • FUEL OIL ADDITIVES • WATER
DE-OILING • METAL DEACTIVATORS

TD-57-2

TRETOLITE COMPANY
A DIVISION OF PETROLITE CORPORATION
369 Marshall Avenue, St. Louis 19, Mo.
5515 Telegraph Road, Los Angeles 22, Calif.

(To obtain more data on advertised products see page 170)

this development of a research idea . . .

helps make

This picture shows the business end of a bright idea for gasolines. It is the heart of the UOP Rexforming process, a new development in petroleum refining that produces automotive gasolines with the industry's highest octane ratings.

The idea was born in our research laboratories. The equipment necessary to make the process commercially practical was developed by UOP design and process engineers.

A lot of scientists, technicians and engineers spared neither brains nor labor in bringing this idea to its successful practical application. And back of it all was the basic purpose of making the gasolines you sell meet today's demand for more efficient motor fuels and perfecting the methods to make its manufacture efficient and economical.

Not only at UOP, but throughout the petroleum industry "men of science" are constantly working to provide the "men who sell" with more marketable products from petroleum. They, too, have an important part in the great economic process of creating demand by making supply more salable.

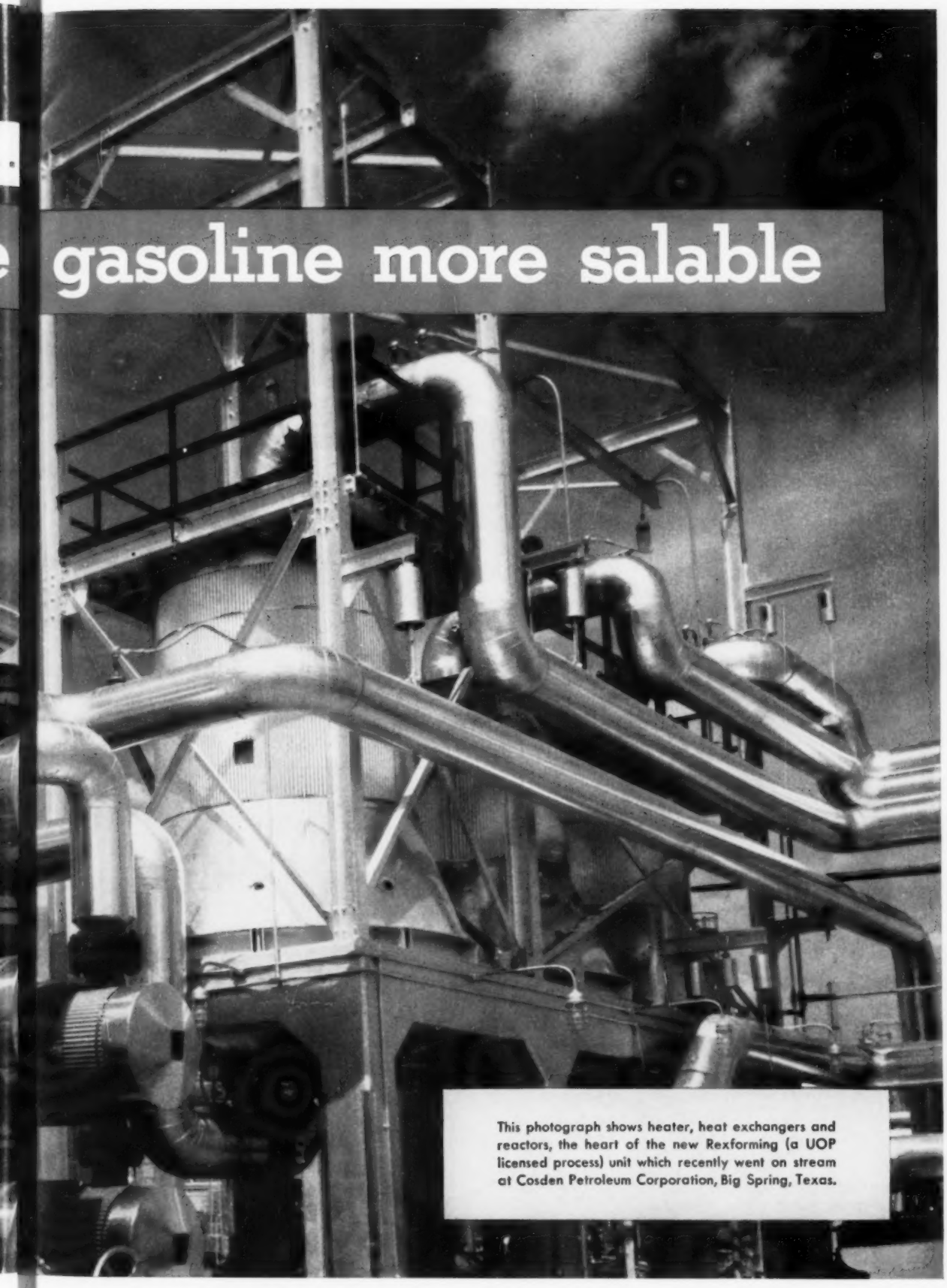
UOP has prepared an interesting booklet on "How Men of Science Help You Sell". We'll be glad to send you a copy on request.

UNIVERSAL OIL PRODUCTS COMPANY

UOP®

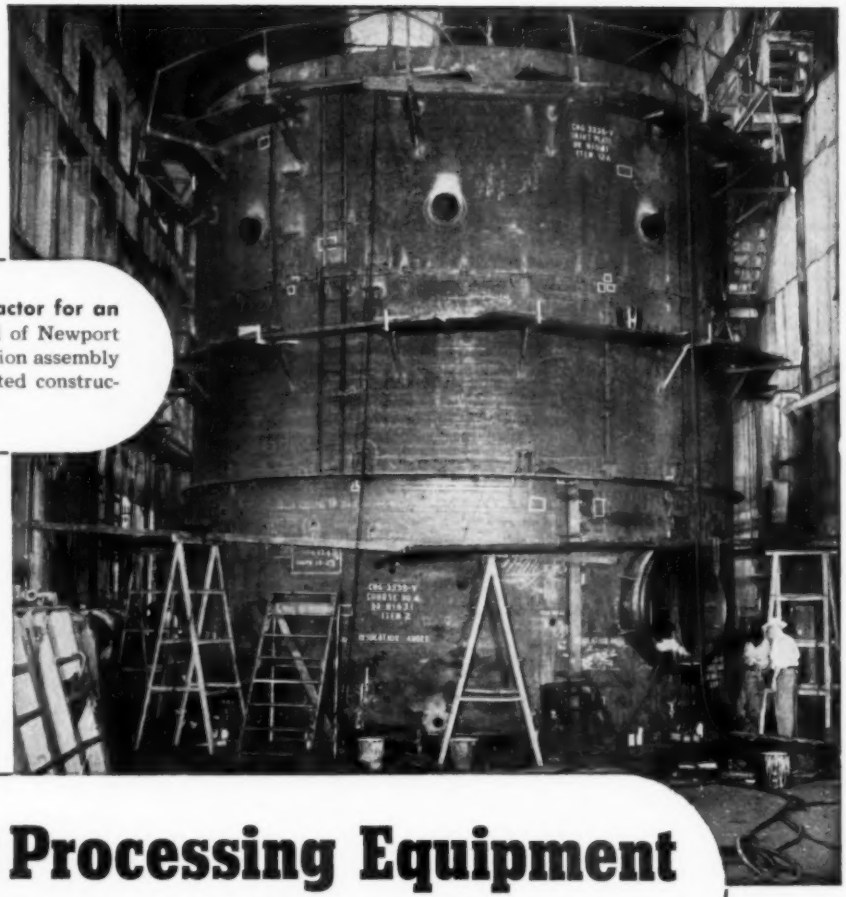
30 Algonquin Road
Des Plaines, Illinois, U. S. A.

Forty Years Of Leadership In Petroleum Refining Technology



This photograph shows heater, heat exchangers and reactors, the heart of the new Rexforming (a UOP licensed process) unit which recently went on stream at Cosden Petroleum Corporation, Big Spring, Texas.

(To obtain more data on advertised products see page 170)



Course number four of a reactor for an overseas oil refinery. Typical of Newport News plant methods, the precision assembly of this unit in the shop expedited construction of the reactor in the field.

Petroleum Processing Equipment

...Built by Specialists in Metal Fabrication

Careful attention to detail characterizes the work of Newport News craftsmen...

They've fabricated millions of tons of steel including corrosion-resistant alloy, clad and other special steels for many diverse industries.

Newport News handles the job exactly as you want it done, for maximum results per dollar invested.

Specialized production techniques, advanced plant methods and a complete range of facilities along with many special purpose machines contribute to the excellence of Newport News fabrication.

Let us bid on equipment for your present or future projects. Learn how Newport News can help you...send for our booklet entitled "Facilities and Products." It's yours for the asking.

Newport News Shipbuilding and Dry Dock Company

Newport News, Virginia

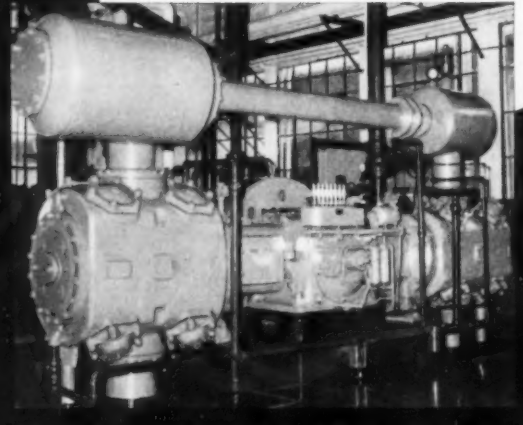
Gene:
Here's another excellent customer report of Cooper-Bessemer compressor performance.
Mike

*Excerpt from a letter written by the Plant Engineer of one of Firestone's foreign subsidiaries.

*This is one piece of equipment we are very happy to recommend to all prospective customers of Cooper-Bessemer. Since this unit was installed, it has operated over 13,800 hours, 6 days a week, 24 hours per day without down time for maintenance. It has given continuous service at rated capacity with no production stoppage or material spoilage.

Very truly yours,

Plant Engineer



Cooper-Bessemer motor-driven EM compressor in a tire manufacturing plant of The Firestone Tire and Rubber Company. This heavy-duty unit, rated 200 hp at 450 rpm, efficiently handles the compression of air from atmosphere to 100 psig.

BRANCH OFFICES: Grove City • New York
Chicago • Washington • San Francisco • Los Angeles
Houston • Dallas • Odessa • Pampa • Greggton
Seattle • Tulsa • St. Louis • Kansas City • Minneapolis
New Orleans • Shreveport • Casper

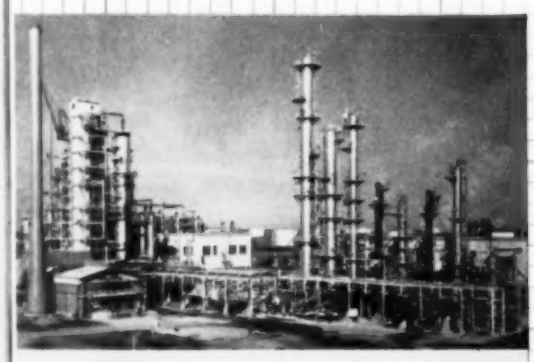
SUBSIDIARIES: Cooper-Bessemer of Canada, Limited . . . Edmonton • Calgary • Halifax.
Cooper-Bessemer International Corporation . . .
New York • Chacao • Havana • Mexico City.

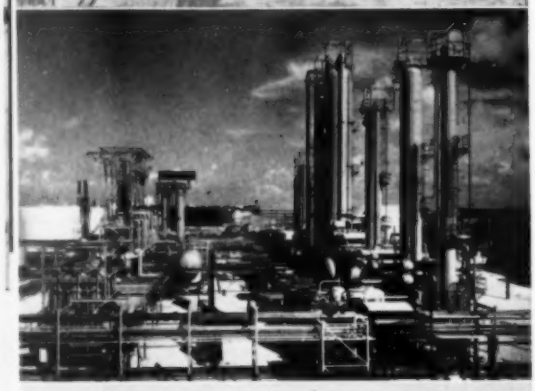
Cooper Bessemer

GENERAL OFFICES: MOUNT VERNON, OHIO

ENGINES · GAS · DIESEL · GAS-DIESEL
COMPRESSORS · RECIPROCATING AND CENTRIFUGAL
ENGINE OR MOTOR DRIVEN

McKee builds plants that EARN PROFITS





YOU may have many reasons for building your new plant—increased capacity, new production processes, new products, more advantageous location—but, in the final analysis, they all add up to one purpose—***net profit for your company.***

And that's the underlying purpose of all McKee engineering and construction—to produce for you a plant designed and built to earn a profit. We have been doing this for for more than fifty years.

The fund of practical knowledge and experience gained on upward of a billion dollars worth of projects in thirty-five countries can be invaluable to you in your new plant. We'll be glad to give you all the facts on the cost-saving, time-saving advantages of McKee services.

McKEE BUILDS PLANTS
THAT EARN PROFITS

McKee
ENGINEERING & CONSTRUCTION
Services

Arthur G. McKee & Company • Engineers and Contractors
Headquarters: McKee Building • 2300 Chester Avenue • Cleveland 1, Ohio
Offices: New York, N. Y. • Union, New Jersey • Washington, D. C.
British Representatives of Metals Division: Head, Wrightson & Co., Limited
Canada: Arthur G. McKee & Company of Canada, Ltd., 372 Bay St., Toronto

New profits

from made-to-order oils!

Oronite®
Lube Oil Additives

Get an added source of income —at no extra cost to you—by providing your customers with custom-formulated oils.

By tailoring Oronite additives to your base oil, you can furnish your customers with exclusive made-to-order oils.

The rapid growth of Oronite, as a major lube oil additive supplier, can be attributed to a willingness to custom-formulate for oil marketers —meeting price and performance specifications. Oronite has compounded and engine tested hundreds of additive compounds and is currently supplying over a hundred different formulations.

It will pay you to discuss compounded motor oils with Oronite. Write or phone our office nearest you.

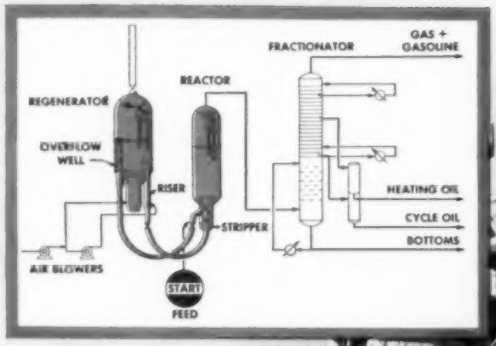
ORONITE CHEMICAL COMPANY

EXECUTIVE OFFICES
200 Bush Street, San Francisco 20, California

SALES OFFICES
San Francisco, New York, Wilmington, Chicago, Dallas, Cincinnati, Los Angeles

EUROPEAN OFFICE
36, Avenue William-Favre, Geneva, Switzerland

4167



*0,800 B/D LION OIL CO. DIVISION OF MONSANTO CHEMICAL CO. UNIT, EL DORADO, ARK.

MODEL IV CAN GIVE YOU FLUID CATALYTIC CRACKING AT LOWEST INVESTMENT COST

Esso Research and Engineering Company offers you *Model IV*, the simplest and most stable *Fluid Catalytic Cracking* process yet developed. The lower investment, maintenance and operating costs of the *Model IV Fluid Catalytic Cracker* are another achievement of the Esso Research program — 38 years of new process developments made available to refiners around the world.

A new compact catalyst transfer system with smaller-sized vessels lowers over-all height and uses far less structural steel. Slide valves are eliminated — inherent self-stability and easy recovery from upset result in long run lengths.

First *Model IV* unit on stream was erected under license in 1952. Twenty-four *Model IV's* have since gone on stream — more than half of their capacity under license. Nine more units are in the construction or planning stage. Flexible *Model IV Fluid Catalytic Cracking* can play an important part in helping you meet changing market demands. We would welcome your inquiry.

ESSO RESEARCH AND ENGINEERING COMPANY

15 West 51st Street, New York 19, N. Y.

Your key to progress... an Esso Research process

OPEN THIS DOOR TO GOOD CITIZENSHIP!

And gain added prestige for yourself and your industry.

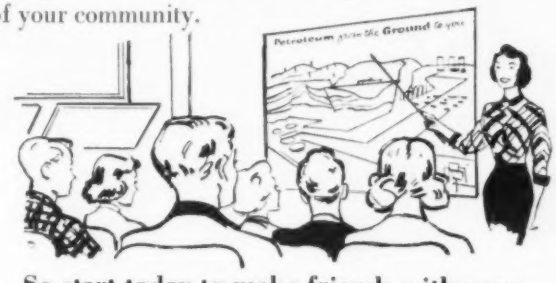
Today, more than ever, good citizenship and good business go hand-in-hand!

Good citizens should be familiar with the problems of their local schools. Good businessmen should be interested in building better community relations. And here's your great opportunity—as an oilman—to do *both* at the same time! You can do it by introducing the oil industry's SCHOOL PROGRAM into your community.

Designed with the advice of educators to fit the needs of secondary schools, the SCHOOL PROGRAM tells the complete, up-to-date story about the oil industry—and the role oil plays in our American way of life. And because today's students will be your customers tomorrow, it's important that they learn the true facts about you and your business. Now *you* are going to be able to supply these facts!

Here's how you do it—

Work with your local Oil Information Committee. You will be provided with a sample package of booklets, charts and films for you to show to the Principal of the school in your town. You'll be surprised at the prestige and goodwill the SCHOOL PROGRAM will bring you and your business. Besides the important local contacts you make, teachers, students and parents will thank you for taking an active part in educating the youngsters of your community.



So start today to make friends with your customers of tomorrow. Fill out this coupon now!

American Petroleum Institute
50 W. 50th St., New York 20, N. Y.

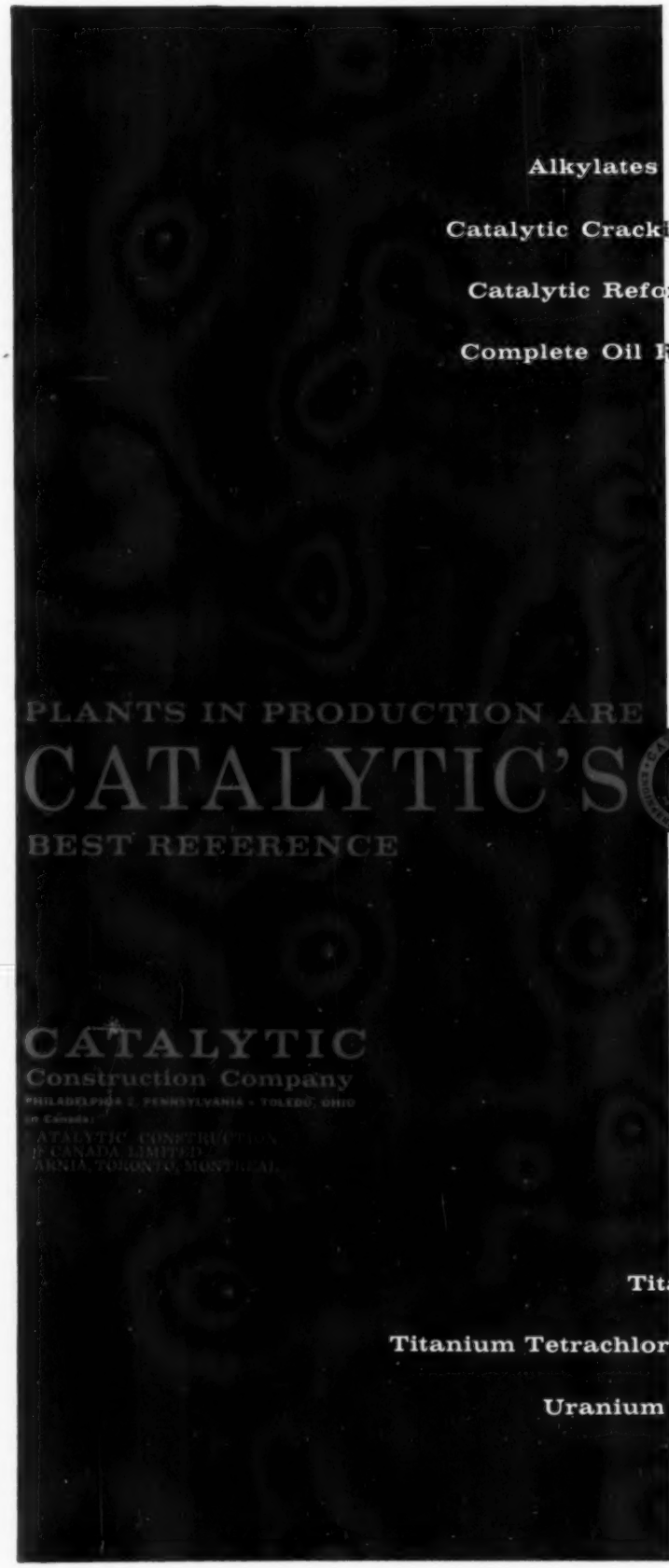
I am interested in promoting the oil industry's SCHOOL PROGRAM in my community. Please send me the address of my nearest Oil Information Committee Field Office.

NAME _____

ADDRESS _____

CITY _____ STATE _____

 (To obtain more data on advertised products see page 170)



Alkylates

Catalytic Cracking

Catalytic Reforming

Complete Oil Refineries

Ammonia

Butadiene

Vinyl Chloride

Dibasic Acids

Fatty Acid Nitriles

Isotrons

Phenolic Resins

Polyester Resins

Polystyrene Resins

Urea

Columbium

Gold

Nickel

Thorium

Titanium

Titanium Tetrachloride

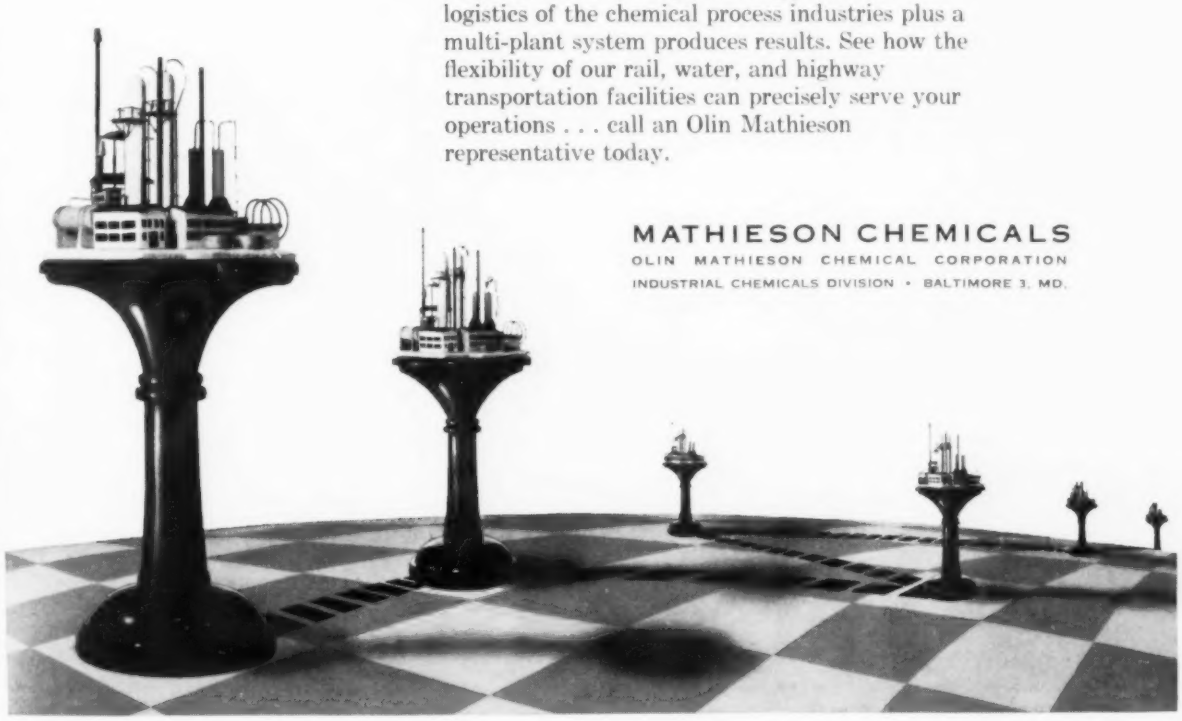
Uranium

ubiquitous chemicals

CHEMICAL PROGRESS WEEK APRIL 8-12

Where needed, when needed—maximum dependability of chemical supply is best assured by a multi-plant set-up. It smooths out local shortages and surpluses . . . assures you of shipments on schedules that meet your most exacting requirements.

Olin Mathieson's imaginative approach to the logistics of the chemical process industries plus a multi-plant system produces results. See how the flexibility of our rail, water, and highway transportation facilities can precisely serve your operations . . . call an Olin Mathieson representative today.



MATHIESON CHEMICALS
OLIN MATHIESON CHEMICAL CORPORATION
INDUSTRIAL CHEMICALS DIVISION • BALTIMORE 3, MD.

MATHIESON

INORGANICS: Ammonia • Bicarbonate of Soda • Carbon Dioxide • Caustic Potash • Caustic Soda • Chlorine • Hydrazine and Derivatives • Hypochlorite Products • Muriatic Acid • Nitrate of Soda • Nitric Acid • Soda Ash • Sodium Chlorite Products • Sulphate of Alumina • Sulphur (Processed) • Sulphuric Acid • **ORGANICS:** Ethylene Oxide • Ethylene Glycols • Polyethylene Glycols • Glycol Ether Solvents • Ethylene Dichloride • Dichloroethylether • Formaldehyde • Methanol • Sodium Methylate • Hexamine • Ethylene Diamine • Polyamines • Ethanolamines • Trichlorophenol

4688

Solvent Decarbonizing gets

MORE

OUT OF YOUR CAT CRACKER

Kellogg Solvent Decarbonizing helps refiners get more profitable products from their cat crackers because it squeezes more profitable feedstock from each barrel of crude processed.

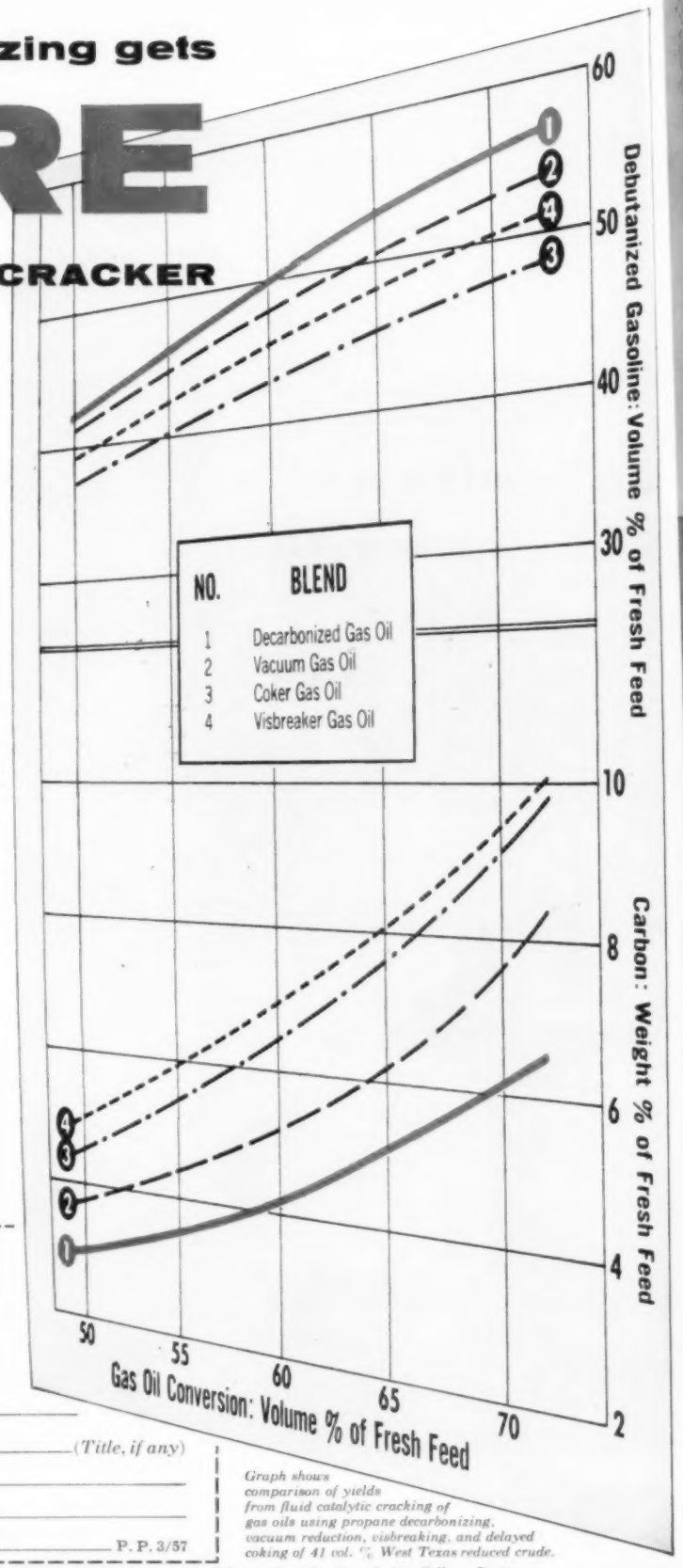
Used as a supplement to vacuum distillation, Solvent Decarbonizing can recover 40 to 75 percent of valuable catalytic feed from residues which would otherwise go to fuel or thermal cracking.

Result: More and Higher Octane Gasoline, when and as required . . . More Light Olefins for alkylation, polymerization, petrochemicals . . . More Flexibility in meeting varying fuel oil and distillate demands. And, with all this . . . more relief from corrosion and fouling.

A detailed description of Solvent Decarbonizing and evidence of its strong economic position in the process scheme are given in Issue No. 3, 1956, of M. W. Kellogg's 16-page "Kelloggram".

THE M. W. KELLOGG COMPANY
711 Third Avenue, New York 17, N. Y.
A Subsidiary of Pullman Incorporated

KELLOGG



Graph shows comparison of yields from fluid catalytic cracking of gas oils using propane decarbonizing, vacuum reduction, visbreaking, and delayed coking of 41 vol. % West Texas reduced crude.

Refinery Process Division
THE M. W. KELLOGG COMPANY
711 Third Avenue, New York 17, N. Y.

Send copy of your 16-page Kelloggram, describing Solvent Decarbonizing and its economic advantages.

Name_____

_____ *(Title, if any)*

Company_____

Address_____

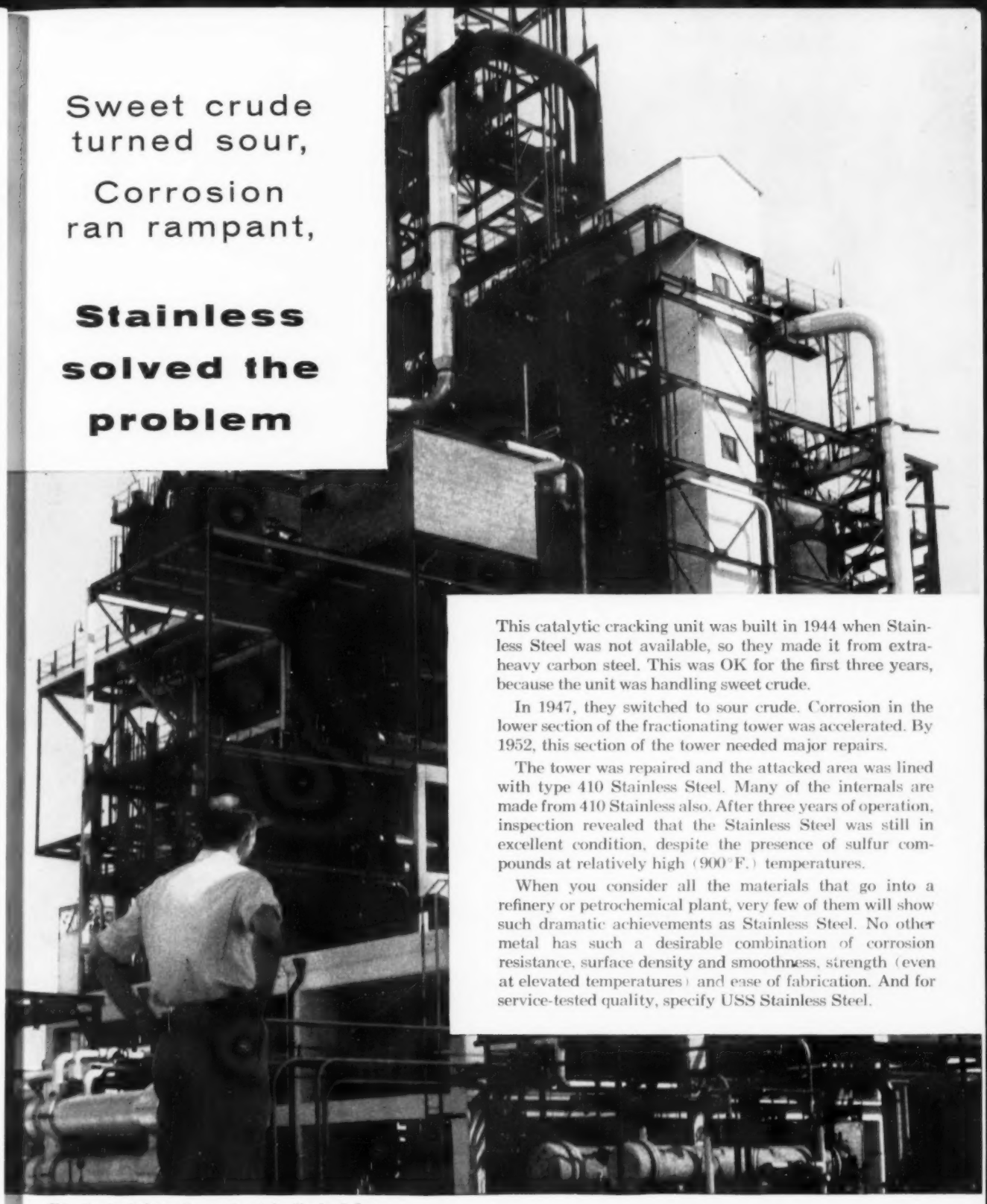
_____ P. P. 3/57

The Canadian Kellogg Company Limited, Toronto • Kellogg International Corporation, London • Societe Kellogg, Paris
Kellogg Pan American Corporation, New York • Companhia Kellogg Brasileira, Rio de Janeiro • Compania Kellogg de Venezuela, Caracas

Sweet crude turned sour,

Corrosion ran rampant,

Stainless solved the problem



This catalytic cracking unit was built in 1944 when Stainless Steel was not available, so they made it from extra-heavy carbon steel. This was OK for the first three years, because the unit was handling sweet crude.

In 1947, they switched to sour crude. Corrosion in the lower section of the fractionating tower was accelerated. By 1952, this section of the tower needed major repairs.

The tower was repaired and the attacked area was lined with type 410 Stainless Steel. Many of the internals are made from 410 Stainless also. After three years of operation, inspection revealed that the Stainless Steel was still in excellent condition, despite the presence of sulfur compounds at relatively high (900°F.) temperatures.

When you consider all the materials that go into a refinery or petrochemical plant, very few of them will show such dramatic achievements as Stainless Steel. No other metal has such a desirable combination of corrosion resistance, surface density and smoothness, strength (even at elevated temperatures) and ease of fabrication. And for service-tested quality, specify USS Stainless Steel.

Cities Service Refining Corporation, Lake Charles Refinery

UNITED STATES STEEL CORPORATION, PITTSBURGH • AMERICAN STEEL & WIRE DIVISION, CLEVELAND • COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO
NATIONAL TUBE DIVISION, PITTSBURGH • TENNESSEE COAL & IRON DIVISION, FAIRFIELD, ALA. • UNITED STATES STEEL SUPPLY DIVISION, WAREHOUSE DISTRIBUTORS
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

USS STAINLESS STEEL

SHEETS • STRIP • PLATES • BARS • BILLETS • PIPE • TUBES • WIRE • SPECIAL SECTIONS

7-73

UNITED STATES STEEL

NEWS OF CHEMICALS FROM **KOPPERS**

"dbpc® antioxidant effectively inhibits gum formation"

says SOCONY MOBIL

Why does Socony Mobil use **dbpc** antioxidant, made by Koppers, in both its regular and premium grades of gasoline? Because **dbpc** gives excellent protection against gum formation in gasolines, yet is easily and safely handled, does not induce tank sweetening, is insoluble in aqueous alkali and is low in cost. The combination of good inhibition and *lack* of detrimental characteristics is helping Socony Mobil achieve good stability at low cost.

dbpc is effective in aviation fuels and anti-knock fluids, too . . . and helps prevent sludge formation in insulating oils and industrial oils.

dbpc has, in some cases, enabled refiners to save money by diverting a portion of their distillates to less expensive and less severe finishing operations. It may help you in this way. Write for complete information. Koppers Company, Inc., Chemical Division, Dept. PP-37, Pittsburgh 19, Pennsylvania.

Mobilgas

KOPPERS

KOPPERS CHEMICALS

Sales Offices: PITTSBURGH · NEW YORK · BOSTON · PHILADELPHIA · ATLANTA · CHICAGO · DETROIT · HOUSTON · LOS ANGELES · SAN FRANCISCO

In Canada: Dominion Anilines and Chemicals Ltd., Toronto, Ontario

Tomorrow's Challenge

Meeting the challenge of tomorrow demands advanced designing, engineering and construction methods. It calls for greater investment in superior facilities at home and abroad to produce new and improved processes and techniques. All these are needed to secure and extend the greatest markets of our time.

The REFINERY ENGINEERING Company is meeting tomorrow's challenge *today* with its broadening versatility; its expanding equipment, staff and area of operations. Oil refining, petrochemical and rare earth and ore industries are offered a complete service, from basic research through site selection, design, engineering and construction — *anywhere.* This is backed by ample financial resources to assure on-schedule completion of any project. A discussion of your proposed expansion is invited.

TRECo

A DIVISION of VITRO CORPORATION of AMERICA

The REFINERY ENGINEERING Company

NEW YORK TULSA TORONTO

New Taylor TRAN

Gives Superior

Taylor Instruments

(To obtain more data on advertised products see page 170)

SCOPE* Controller

Performance in a Small Package

Latest addition to famous Transet line uses unique Motion-Balance principle. Proven by months of tests on toughest applications.

HERE'S the first in a series of new Taylor TRANSCOPE instruments that will set new standards of process control performance. It's the new TRANSCOPE Controller—a miniature controller that's new in design, new in principle . . . and in performance has no equal, particularly on applications where the span of measurement is very short. It is ideal for the time constants of modern processing.

Simple to adjust, easy to maintain—and to convert from one form of control to another, the TRANSCOPE Controller can be panel, rack or field mounted. The adjustable proportional response system is based on the Motion-Balance principle that uses bellows as pressure sensitive elements. The illustration on the opposite page shows how the instrument looks—here's what it means in your plant:

1. Exceptionally fast and smooth response—particularly important on start-ups.

2. Ease of alignment—smooth-acting screw-driver adjustment because of ball-bearing construction.

3. New high standard of accuracy and setting for gain, reset and Pre-Act responses.

4. Outstanding in its insensitivity to ambient temperatures.

5. Very low air consumption—only 0.1 scfm.

6. Adaptability to changes in process requirements . . . complete interchangeability of components so you can convert from simplest to most complex forms of control *in the field.*

7. Instrument action is reversed by merely rotating a dial.

8. Integral cut-off relay—a *built-in feature*—for field-mounted or panel-mounted use.

9. Plugs into Transet Indicators or Recorders or locally-mounted manifolds.

10. Friction-free bending member . . . no maintenance because no wear.

11. Easy access to nozzle and baffle.

12. Rugged bellows construction keyed in position. Dynamically-balanced force plate.

13. Stainless steel nozzle and baffle . . . hardened stainless reaction members . . . rugged aluminum assemblies. Dust and moisture-proof case suitable for outdoor mounting.

Write for Bulletin 98278.

• • •

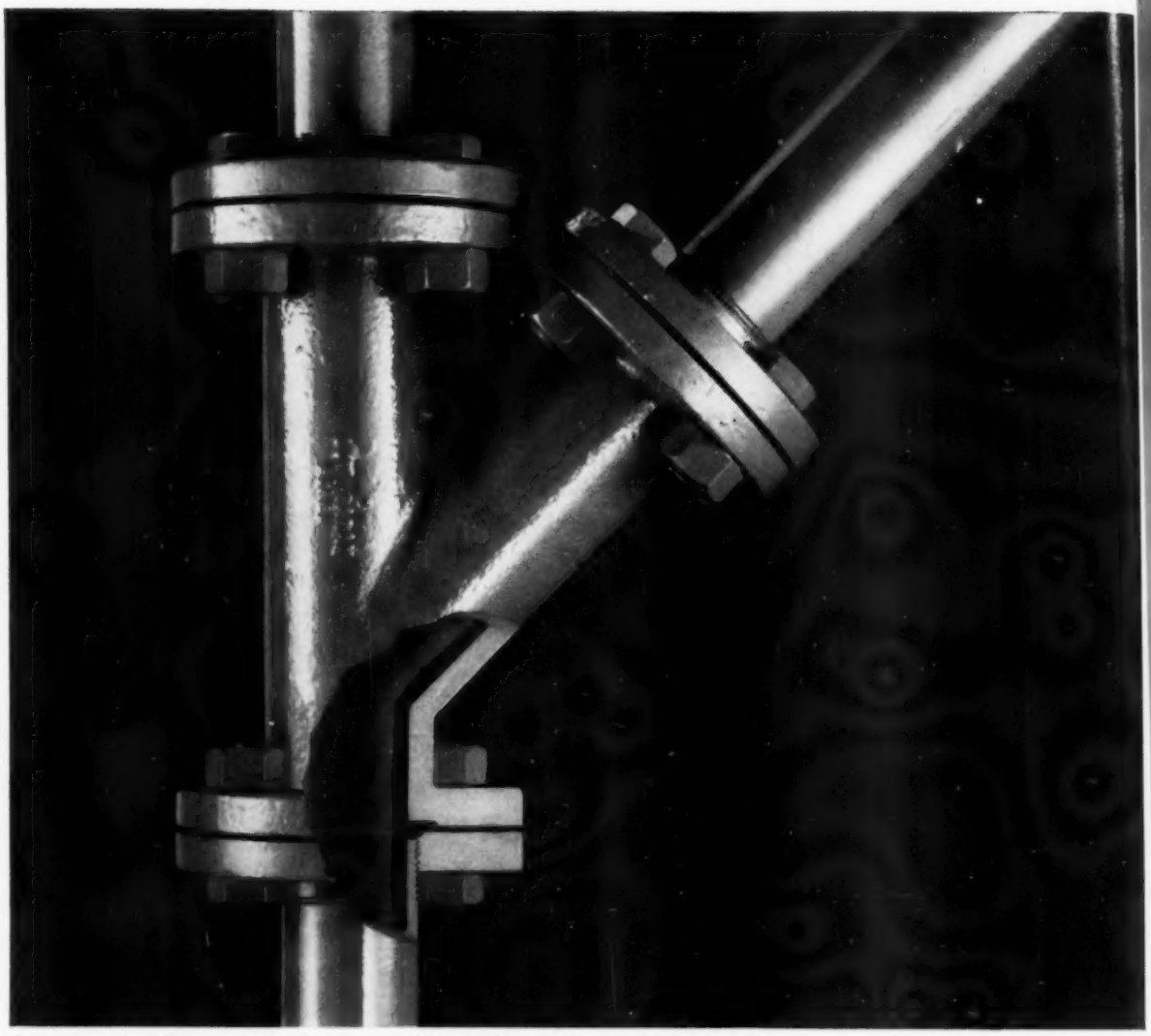
Taylor Instrument Companies, Rochester, N. Y., and Toronto, Canada.

Instruments for indicating, recording and controlling temperature, pressure, flow, liquid level, speed, density, load and humidity.

*Trade Mark

MEAN ACCURACY FIRST

 (To obtain more data on advertised products see page 170)



Cutaway view shows how corrosive liquids are prevented from touching metal in saran lined pipe and fitting.

You can see why saran lined pipe is so corrosion resistant!

It's steel pipe lined with durable saran . . . acids, alkalies can't harm it

Corrosive liquids won't harm this pipe, its fittings or its valves. A thick, tough saran lining completely protects it from commonly used acids, alkalies, other corrosive liquids.

It's strong, too. Saran lined pipe will withstand working pressures up to 300 psi. Saran lined valves and fittings are available for working pressures of 150 and 300 psi. You can use the same supports you would use with ordinary steel pipe.

Ease of fabrication will keep your installation costs down. Cutting and threading can be readily accomplished in the field with conventional hand tools or power equipment.

For tomorrow's protection, investigate saran lined pipe today. THE DOW CHEMICAL COMPANY, Midland, Michigan.

SARAN LINED PIPE COMPANY
DEPT. SP1591F
2415 BURDETTE AVENUE
FERNDALE 20, MICHIGAN

Please send me information on saran lined pipe, fittings and valves.

Name_____ Title_____ Company_____

Address_____ City_____ State_____

YOU CAN DEPEND ON DOW

(To obtain more data on advertised products see page 170)

Bingham "KOKE-KRUSHER" HOT OIL PUMP

NON-CLOGGING!

PULVERIZES LARGE PIECES OF ENTRAINED COKE IN PUMPAGE

Bingham Type CKM "Double Volute", Two Stage, "KOKE-KRUSHER" for handling hot, coke-laden pumpage at high heads.

- Results in more hours on stream—less down time.
- The pulverizing action on entrained solids reduces clogging of other system equipment.
- Non-pulsating flow eliminates need of auxiliary equipment for control of pressure and/or capacity.
- Eliminates expensive protective devices.
- Smooth pump characteristics eliminate destructive vibration.
- Lower maintenance. Only one moving part.

HANDLES COKE-LADEN HOT OIL IN CRACKING SYSTEMS WITHOUT CLOGGING

The Bingham "Koke-Krusher", the only pump that crushes coke, is a field-proven, centrifugal pump specially designed for the severe services of pumping oil products such as *Residuum, Flash Tower Bottoms, Black Oil Recycle*—in which the oil carries in suspension pieces of hard coke of irregular size and shape.

This revolutionary Bingham pump features a coke crushing mechanism located in the suction chamber immediately in front of the impeller eye. Any piece of solid coke entrained in the pumpage *must* pass through the crusher, where it is instantly pulverized, before entering the impeller.

The resulting pulverized coke particles are small enough to assure free flow through the pump and all system equipment. The Bingham "Koke-Krusher" will make a big difference in your operations. Call your nearest Bingham office for full details. Send for Bulletin 106.

PARTIAL LIST OF MAJOR OIL COMPANIES WITH BINGHAM KOKE-KRUSHER PUMPS IN OPERATION OR ON ORDER

ESSO Standard Oil Company
Gulf Oil Company
Texas Oil Company
Canadian Petrofina, Ltd.
Champlin Refining Company
Shell Oil Company
Sinclair Refining Company
Socony Mobil
Imperial Oil Company, Ltd.
McColl Frontenac Oil Co., Ltd.

Bingham SINCE 1921

DOUBLE VOLUTE PUMPS RADIAL BALANCE

BINGHAM PUMP COMPANY

General Offices: **2800 N.W. Front Avenue, Portland 10, Oregon**

Factories: **Portland, Ore. • Vancouver, B. C., Canada**

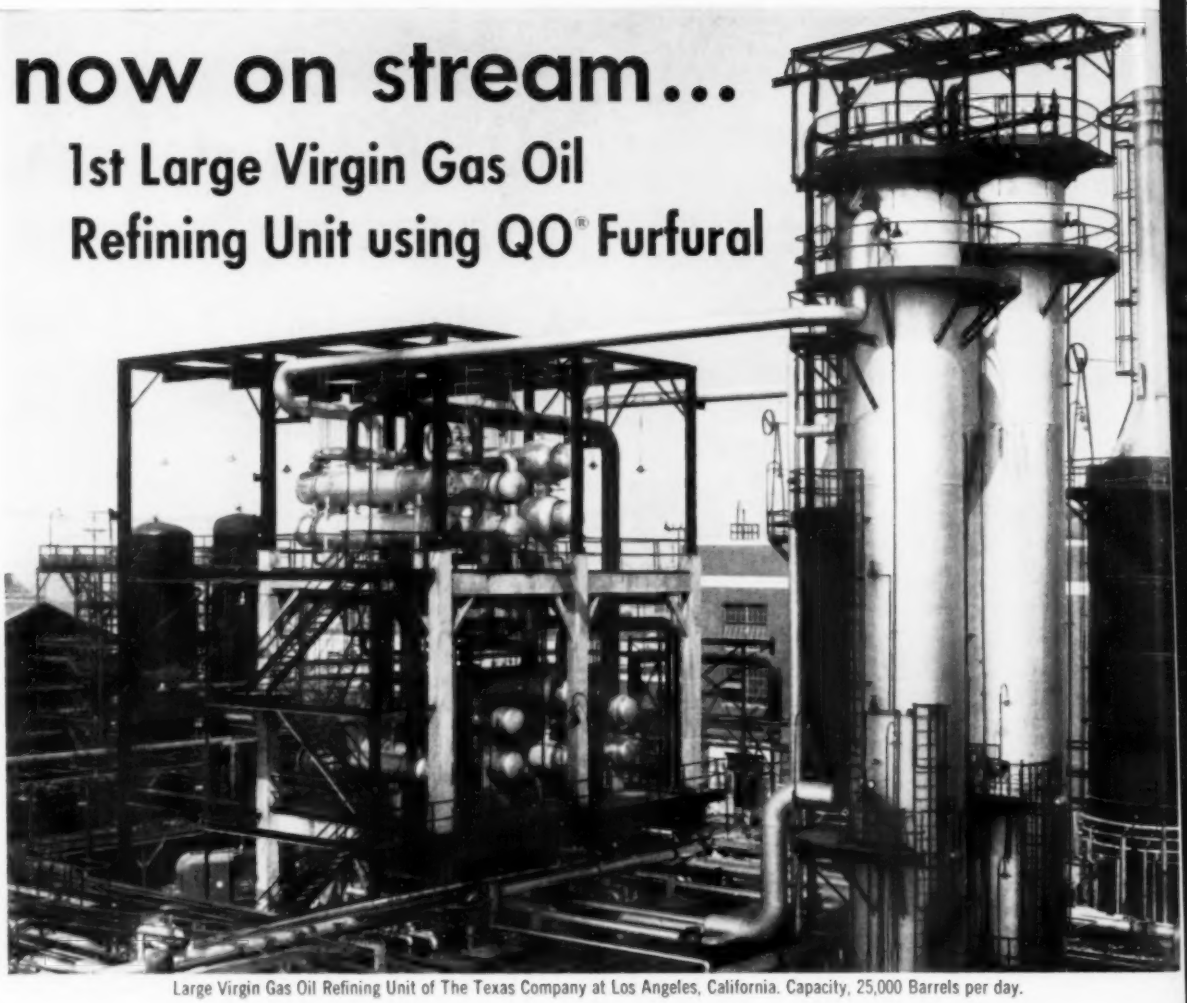
SALES AND SERVICE OFFICES

BOSTON, MASS.
CHICAGO, ILL.
CLEVELAND, OHIO
DALLAS, TEXAS
DENVER, COLO.
HOUSTON, TEXAS
KANSAS CITY, MO.
LOS ANGELES, CALIF.
NEW ORLEANS, LA.
NEW YORK CITY, N.Y.
PHILADELPHIA, PA.
PITTSBURGH, PA.
SAN FRANCISCO, CALIF.
SEATTLE, WASH.
ST. LOUIS, MO.
ST. PAUL, MINN.
TULSA, OKLA.
TORONTO, ONT., CAN.
VANCOUVER, B. C., CAN.

(To obtain more data on advertised products see page 170)

now on stream...

1st Large Virgin Gas Oil Refining Unit using QO® Furfural



Large Virgin Gas Oil Refining Unit of The Texas Company at Los Angeles, California. Capacity, 25,000 Barrels per day.

Furfural is used to prepare stocks for catalytic cracking because it:

- Removes carbon-forming material
- Extracts heavy metal contaminants
- Decreases sulfur content
- Reduces aromatic content
- Produces high yield of raffinate to be charged to fluid catalytic cracking unit

Results are:

- Improved quality and yield of gasoline
- Lowered operating cost of gasoline production due to increased catalyst life

Not to be overlooked is the fact that when necessary, furfural can refine in one unit, lube oil, cycle stock or virgin gas oil as demand dictates. In all three operations QO furfural offers excellent selectivity, ease of recovery, low cost, ready availability, and freedom from excessive toxicity. The process to refine hydrocarbon oils with furfural is licensed by Texaco Development Corporation, 135 East 42nd Street, New York 17, New York.

Write for our Bulletin 203-A
"Physical Data on Furfural"

The Quaker Oats Company
CHEMICALS DEPARTMENT

The Quaker Oats Company — CHEMICALS — QO FURFURAL CHEMICALS — DEPARTMENT

339G The Merchandise Mart,
Chicago 54, Illinois

Room 539G 120 Wall St.,
New York 5, N. Y.

Room 439G 48 S.E. Hawthorne Blvd.
Portland 14, Oregon

In the United Kingdom:
Imperial Chemical Industries, Ltd., Billingham, England

In Europe:
Quaker Oats-Graanproducten N. V., Rotterdam, The Netherlands;
Quaker Oats (France) S. A., 3, Rue Pillet-Will, Paris IX, France;
A/S "Ota", Copenhagen, S. Denmark

In Australia:
Swift & Company, Pty., Ltd., Sydney

In Japan:
F. Kanematsu & Company, Ltd., Tokyo

Whatever the GRADE and the VOLUME of

NATURAL GASOLINE

Just rely on WARREN'S versatile facilities to give you dependable deliveries . . . WHERE and WHEN and the WAY *you* want them.

WARREN

PETROLEUM CORPORATION

TULSA, OKLAHOMA • Cable Addresses: STAVOLENE, WARREN

EXPORT TERMINALS: CORPUS CHRISTI, PORT ARTHUR, BAYTOWN, TEXAS CITY AND WARRENGAS, HOUSTON, TEXAS, SAN PEDRO, CALIF.

Can you answer these **5 cost-cutting questions** *about big-tank mixers?*

If you can, you know how to get most efficient mixing for your company

1 How can I get mixer shaft seals that meet any operating conditions? It's easy—just standardize on LIGHTNIN Mixers for your big tanks. Get your choice of *four* standard stuffing boxes, or a wide choice of rotary mechanical seals. With LIGHTNINS, you're sure of getting the *right* shaft seal for years of trouble-free mixing or blending.

2 What's the advantage of LIGHTNIN cartridge-type rotary mechanical shaft seal? No stuffing box to repack or maintain. You can replace the LIGHTNIN Seal in minutes, if it ever wears out. No need to drain the tank or dismantle the mixer; no need for special skill—you're back in operation fast! Many users of the LIGHTNIN Seal are saving thousands of dollars per year with this exclusive feature.

3 What's the quickest, simplest way to shut off tank contents before repacking, or changing a seal? The LIGHTNIN way! Easy-to-get-at handles are out in the open, always accessible. A few turns provide quick, positive shutoff of tank contents from mixer. Only LIGHTNIN gives you this time-saving advantage.

4 What mixer gives me most protection of the drive gears? LIGHTNIN again! The mixer shaft, in LIGHTNIN gear drive models, passes through a hollow drive quill. Shaft and quill are supported by separate sets of bearings, connected only by a flexible coupling. This coupling cushions shaft flexures and strains—keeps excessive shock loads from ever reaching the gearing. This construction adds years of safe operating life.

5 What's a good way to keep motor safe from dirt, dust, excessive moisture? Put the motor on top! This design, exclusive with LIGHTNIN, not only protects the motor; it centers weight closer to tank wall. You can choose standard foot-mounted motors, as shown, or round-frame NEMA Type P flange-mounted motors in all enclosures and all current characteristics. All motors are fully guaranteed.

These are just five of the engineering reasons why you get better, lower-cost mixing with LIGHTNIN Mixers. Your nearby LIGHTNIN representative can show you more. For quick, competent help on fluid mixing, look him up in Refinery Catalog. Or write us direct.

CUT MAINTENANCE COST with this quickly replaceable cartridge-type rotary seal, available on all LIGHTNIN Side Entering Mixers. Seal takes the place of a stuffing box; ends repacking for good; runs for years without adjustment; *slides off* for fast, easy replacement.

Lightnin® Mixers

MIXCO fluid mixing specialists

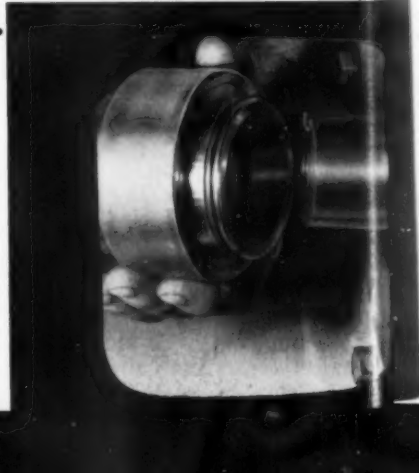
☐ ***Quick!*** **Send us the cost-cutting facts on LIGHTNIN Rotary Mechanical Seals—Bulletin B-111. We'd also like catalog information on these LIGHTNIN Mixers:**

- ☐ B-102—Top or bottom entering; turbine, paddle, and propeller types: 1 to 500 HP
- ☐ B-103—Top entering propeller types: ¼ to 3 HP
- ☐ B-104—Side entering: 1 to 25 HP
- ☐ B-108—Portable: ⅛ to 3 HP
- ☐ B-112 Laboratory and small-batch production types
- ☐ B-110—Condensed catalog showing all types
- ☐ B-107—Data sheet for figuring mixer requirements

Check, clip, and mail with your name, title, company address to:

MIXING EQUIPMENT Co., Inc., 131-c Mt. Read Blvd., Rochester 11, N. Y.

In Canada: Greey Mixing Equipment, Ltd., Toronto 10, Ont.



Petroleum Processing
March, 1957

FUEL INJECTION

Will it bring new gasoline datterns?

By V. B. GUTHRIE,
Associate editor

TODAY, three fuel injection systems are commercially available for passenger automobiles. More are known to be in research and development stages in the automobile and carburetor companies.

Significant changes in motor gasoline could—and probably will—result from a wide application of these systems. Among these, the six most important probabilities are:

- Better gasoline economy.
- A slowdown in the octane race.
- Elimination of need for distillation range variations.
- Use of heavier fractions than present specifications allow.
- Use of more of the higher boiling aromatics.
- Reduction in the vapor lock problem.

How soon such changes will come about depends on the extent to which fuel injection takes hold in the nation's passenger cars.

It is more an economic than a technological question. It will be resolved when fuel injeciton systems, now costing from $400 to $500, can be installed in a car for around the price of the four-barrel carburetor, which runs $50 to $60. Full benefits will be achieved, the automotive engineers say, only when the concept of fuel injection has been integrated into overall engine design.

In any case, oil companies expect several years to pass before fuels will have to be tailored to fit injection systems. They feel it will take that long before the number of injection systems will rise to any significant volume.

The three systems already available today are offered by General Motors Corp., Bendix Aviation Corp., and the American Bosch Division of American Bosch Arma Corp. (See next page.)

The GM system is available in limited quantities. It is optional on the 1957 Chevrolet, but few are reported being sold to the public. Their installation adds between $400 and $500 to the price of the car. GM is also introducing its fuel injection system through the Pontiac Division for limited 1957 production on the Bonneville Convertible model, and it is being sold to dealers only.

A few oil companies have ordered 1957 Chevrolets with fuel injection for carrying on studies in their automotive laboratories. One oil firm has a German Mercedes Benz with fuel injection, also for experimental work.

In the main, petroleum automotive engineers are watching from the sidelines to see what types of fuel injection systems take the lead in commercial development. They recognize that much more is involved than simply substituting the injection pump for a carburetor. Fuel may be injected directly into the combustion chamber, or it might enter the intake port behind the intake valve, or at other points along the intake manifold.

There are also a variety of methods for metering the fuel. One technique might be to base it on engine speed and intake manifold pressure. Another might be to make it a function of intake airflow velocity. The fuel may be supplied in timed, measured amounts or in a continuous flow, through separate lines to each cylinder or through one common line. It may be metered by positive displacement injection pumps, by distributor valves, or by a pressure carburetor.

No matter what system is finally adopted, there will be some technological fuel problems, refiners realize. But the changes in fuel requirements will largely be economic, it is believed.

Better gasoline economy: Automobile company engineers believe savings in gasoline consumption up to 20% can be achieved with engines designed to use fuel injection most efficiently.

Such savings could be made economically attractive to the motorist if they were passed along to him and not expended in building larger and more powerful cars. Today's average passenger automobile uses about 700 gal of gasoline in a year. At current prices for regular grade, the motorist spends about $215 a year for that gasoline. A 20% improvement in gasoline mileage would mean he could save about $40 annually.

A slowdown in the octane race: Providing the automotive design engineer with a means of attaining 10 to 15% more engine power through fuel injection might slow down the continuous rise in motor fuel octane requirements. It could be a sub-

stitute for the continual upward push on compression ratios to get the increased power the automobile companies think the public wants.

Elimination of distillation range variations: The wider latitude in distillation range of fuels required by liquid injection will offer some advantages to refiners. A rise in the 90% and final boiling points of regular grade fuel would make it possible for the processor to approach more equal summer and winter plant operations. This would hold also, of course, for variations in geographical location of marketed products.

In the summer season of high volume demand, more of the fractions in the heavy naphtha and kerosine range could go into motor fuel. And in the winter, these cuts could be switched to make up the required volumes of distillate fuel oils.

Fuel injection systems could also provide compensation for variations in altitude, the auto engineers say. A still further advantage would be a provision for the automatic cutoff of fuel flow to the engine during deceleration, which would reduce air pollution—a large contributor to smog conditions in some areas of the country.

Heavier fractions could be used than are now allowed in gasoline specifications, as indicated above, through the increase in the 90% and tail-end volatility requirements.

More higher-boiling aromatics could also be used in the final blends, according to some refiners, as another result of this rise in tail end volatility. This could tend toward an increased octane number in finished gasoline.

Reduction in the vapor lock problem: Improving the *front end* volatility with fuel injection will come mainly through the redesign of the engine induction system, oil company automotive engineers believe. This would avoid the high temperatures now required in the manifold to maintain fuel vaporization. Besides allowing use of more light hydrocarbons in the fuel, the volumetric efficiency of the engine would be increased.

The only published experience on the operation of fuel injection systems on conventional passenger automobiles comes from GM's Pontiac Division. J. F. Verkerke of Pontiac reported to the annual meeting of the Society of Automotive Engineers in Detroit in January on GM experience with some models that had gone only to dealers:

"While our main goal for this year has been to produce a power plant having all the advantages that fuel in-

How three fuel injection systems work

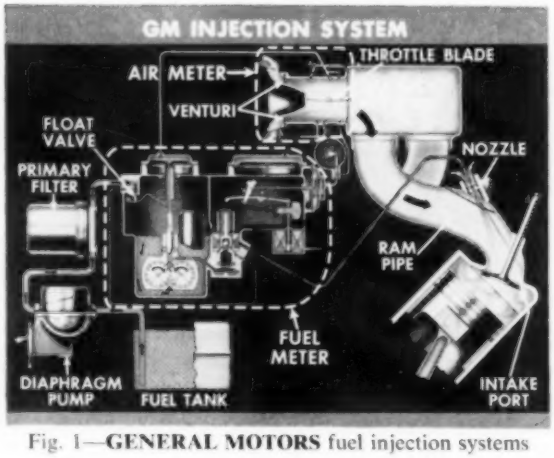


Fig. 1—**GENERAL MOTORS** fuel injection systems

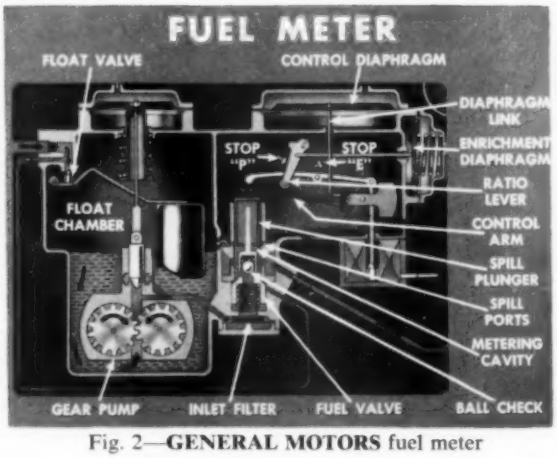


Fig. 2—**GENERAL MOTORS** fuel meter

General Motors

Mass flow metering is heart of system

THE General Motors injection system uses continuous flow injection into the intake ports with open orifice nozzles directing the flow toward the intake valves. The control method is based on mass flow metering in which venturi throat depression is related mechanically to fuel pressure.

Fuel supplied by a conventional 6-psi diaphragm pump passes through a 10-micron primary filter to the fuel meter. (See Fig. 1.) The fuel is admitted through a float valve—similar to its counterpart in a carburetor—into the float chamber (Fig. 2) where any vapors resulting from temperature rise are vented. A small gear pump in the bottom of the float chamber delivers the fuel through a second inlet filter and a fuel valve to the metering cavity.

The fuel valve contains an antipercolation ball check to keep the fuel between the valve and the pump at a sufficiently high pressure to eliminate vapor pockets. Some of the fuel delivered to the metering cavity flows directly to the eight continuous spray nozzles; the remainder of the fuel flows through the spill ports back to the float chamber. The amount of fuel spill is regulated by the spill plunger.

The air enters the air meter (Fig. 1) through the annular venturi section and flows past the throttle blade to the manifold header and then to the individual intake ports. The air velocity through the venturi causes a depression signal related to the mass air flow. This venturi signal acts on the control diaphragm to create a force that is transmitted to the spill plunger by means of the diaphragm link and control arm, the latter being pivoted on the ratio lever.

An increase in air flow through the venturi causes a relative increase in venturi signal which, acting on the control diaphragm, results in an increase in the force acting on the top of the spill plunger. The spill plunger then moves to a new balanced position to obtain a fuel pressure increase proportional to the venturi signal in-

jection can offer for superior performance and smoothness under all driving conditions," he said, "fuel economy has not suffered. We have shown level road fuel economy to be about equal to that obtained on our carburetor cars. During a cross country trip, the fuel injection car averaged more than 5% better overall economy than a comparison car equipped with a conventional four-barrel carburetor.

"Our performance development has been carried on quite extensively at both the hot and cold extremes of weather conditions. Running in the hot climates has proven our fuel injection system to be resistant to vapor locking tendencies, even with high vapor pressure fuels. High altitude running also presented no particular problems. Cold weather development, however, particularly in the range of 0° F, has entailed considerably more study."

There is another side of the coin, however. Some doubts that fuel injection systems in their present stage of development and installed in current model cars offer any significant advantages over carburetor systems were expressed by two Bendix men. F. C. Mock and W. C. Suttle of Bendix Products Division, Bendix Aviation Corp., said in a paper presented before the Philadelphia chapter of SAE:

"Because the temperature in the cylinder walls, in relation to the fuel boiling point, will determine the efficiency of fuel utilization, it seems doubtful that present fuel boiling points can be changed appreciably by injection. Lower volatility will result in irregular firing, carbon deposits, and crankcase dilution just as with carburetor systems.

"It would also be surprising if with injection of present fuels, we would find it desirable to go below present practice for engine jacket temperatures and intake air temperatures in winter.

"Thus it seems unlikely that we will ever reach the triple objective of 1) a good all-around, all-year-round operation on 2) a 'safety fuel' that will not ignite at atmospheric temperatures, combined with 3) the ability to burn all the air charge in the cylinder.

"Use of injection will not eliminate the need for excess fuel feed for starting, nor the need for an equivalent of the automatic choke. For this function, there will be little difference between injecting the excess fuel in the cylinder or dumping it anywhere in the intake air passage, because only the vapor will be ignitable."

---

crease. Because the increased fuel pressure results in a fuel flow proportional to the increase in air flow indicated by the venturi signal, a constant air-fuel ratio will be maintained as long as the linkage ratio is not changed.

The nozzle contains a very accurately calibrated open fuel orifice somewhat less than 1/64 in. diameter. The nozzles, at the entrance of each intake port, are mounted in plastic nozzle holders. Just below the fuel orifice there is a small air chamber that receives filtered air through four 0.100-in. diameter air holes from the air cleaner. This air supply assures that the nozzle discharge is at all times near atmospheric pressure regardless of manifold vacuum fluctuations. Consequently the amount of fuel injected depends solely on the metering system pressure.

In line with the fuel orifice across the air chamber is the opening to the intake port. This is an 0.040-in. diameter air orifice. It should be noted that, under all manifold vacuum conditions, the atomization of fuel is enhanced by the mixing of air and fuel through this 0.040-in. orifice. The air volume passing through the air orifice represents about one fourth of the air used at closed throttle for idling.

(The above is condensed from a section of the paper "The General Motors Fuel Injection System," presented at the annual meeting of the Society of Automotive Engineers, Detroit, Jan. 14-18, 1957.)

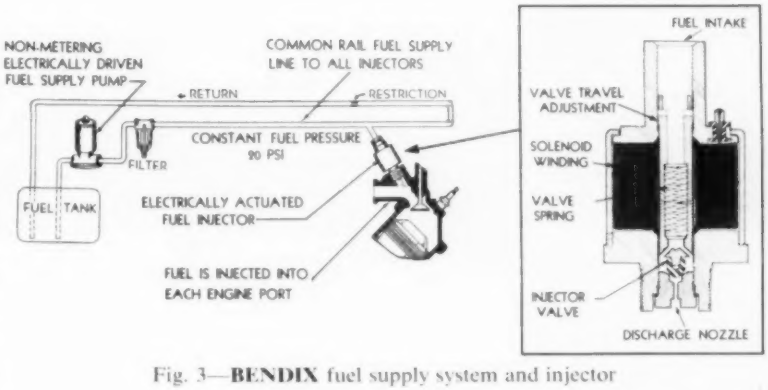


Fig. 3—**BENDIX** fuel supply system and injector

Bendix

Electronics for new approach

THE Bendix "Electrojector" is a new approach to the fuel injection problem for passenger car installations in that it is electronically controlled and electrically actuated.

Fig. 3 indicates the basic fuel supply system, in which fuel is drawn from the fuel supply tank by an electrically-driven, non-metering, fuel supply pump that maintains the line pressure to the fuel injector valve, of which there is one for each cylinder of the engine, at 20 psi plus or minus 0.5 psi. Between the fuel pump and the injector is a fuel filter. In this system it is not necessary to filter the fuel finer than 20 microns particle size, as the system does not have close-fitting, mechanically-operating units.

Experience to date has indicated that the best results are obtained when the fuel is directed at the head of the intake valve, so that a minimum amount of wall wetting results. A fuel return line is incorporated in the system to continually purge any air or fuel vapor from the fuel supply system. To date, there has been no experience with engine malfunctioning due to air or fuel vapor in the lines, even though the system has been subjected to high underhood temperatures and empty fuel lines during a shutdown period.

Details of the solenoid fuel injector valve are also shown in Fig. 3. Fuel enters at the top of the unit and passes through the center core of the valve, discharging through the noz-

zle at the lower end when the injector valve is off its seat or open.

Timed fuel injection, the basis of this system, is accomplished by adding a fuel injection triggering selector unit and rotor to a standard engine distributor. They are inserted as a sandwich between the base of the distributor and the standard ignition distributor cap. In the triggering selector unit, there is a set of breaker points and a distributing commutator with a section of the commutator for each solenoid injection valve.

The breaker points are actuated by the same cam that operated the regular engine ignition points. Thus, for each two revolutions of the engine, the fuel injector breaker points have made and broken contact the same number of times as there are cylinders in the engine. Each time the fuel injector breaker points make contact, a triggering impulse is transmitted to the electronic modulator box after which, the modified signal is returned to the selector portion of the assembly and the impulse is distributed to the correct fuel injector valve.

The first function of the electronic modulator control or brain box is to transform the spike signals received from the triggering selector unit into an electrical pulse of a given standard width. Simultaneously, signals indicating engine operating conditions are also being received by the electronic modulator control from sensing units located on various parts of the engine.

By integrating these external sensing signals into the standard pulse width circuit of the electronic control system, the standard pulse width is modified to reflect engine conditions. This modified electrical pulse is then transmitted to the selector portion of the triggering selector unit, which in turn distributes or directs the pulse to the correct fuel injector, providing best results.

(Condensed from a portion of the paper, "Electrojector Bendix Electronic Fuel Injection System," presented before the annual meeting Society of Automotive Engineers, Detroit, Jan. 14-18, 1957.)

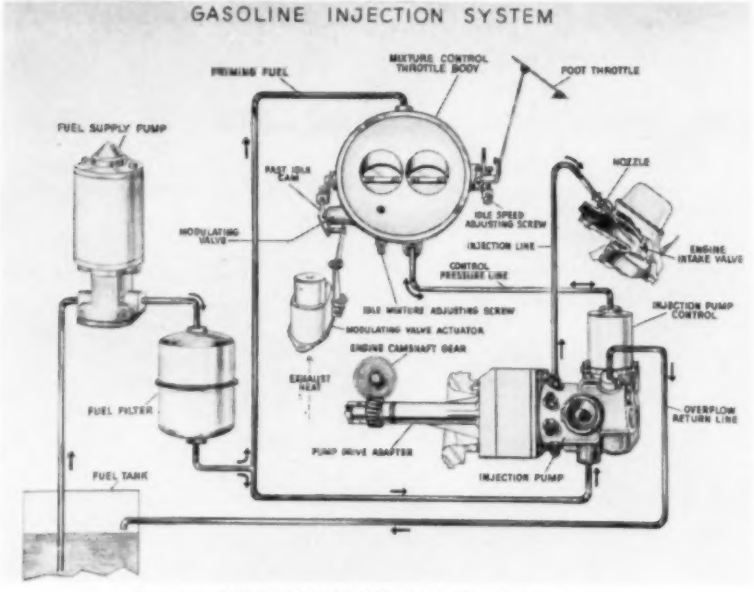


Fig. 4—**AMERICAN BOSCH** fuel injection system

Bosch

Aimed at good cold-starting

IN THE American Bosch Arma Corp. system, fuel is injected at the intake port through a spring-loaded nozzle at about 75-psi fuel pressure. Fig. 4 is a schematic of the system.

The injection pump consists of an integral 8-lobe-face cam and plunger, reciprocating and rotating within a housing. A metering sleeve fitted to the plunger and adjusted for metering position by the eccentric shaft, controls the fuel spill point. The pump is driven from the ignition distributor drive shaft at half engine speed.

During the suction stroke of the pump, fuel from the sump fills the internal volume of the plunger through radial ports in the plunger and sleeve. At the start of the pump stroke, fuel is forced out through the spill ports to the sump for that part of the stroke determined by the metering sleeve position. As the plunger lifts further, the spill ports are covered by the sleeve and fuel is then forced through a delivery valve to the nozzle line. Injection continues to the end of the stroke and the cycle repeats for an adjacent outlet.

The injection pump control is mounted directly on the injection pump, the fuel quantity injected per pump stroke being a function of control pressure applied to the piston.

The mixture control in its basic form is merely a manifold pressure control and throttle body, with a chamber feeding a modified manifold pressure to the injection pump control during cold starting and idling. By this means the control pressure is raised during warmup to increase the pump delivery and insure a fuel flow sufficient for good cold-starting. The operation may be actuated by a manual choke wire or an automatic operator responsive to exhaust or water temperature.

The spray nozzle of the American Bosch system is an outwardly-opening poppet type, consisting of a valve assembly rolled into a holder, which is available in several lengths to satisfy various engine and manifold requirements. Opening pressure is 70 psi.

The fuel filter is especially designed for gasoline. The filter element is built up of alternate layers of high wet-strength paper and fiber spacers inside a steel enclosure and provides 2-micron filtering of the fuel. Service life is said to be approximately 30,000 miles.

The fuel supply pump consists of an electric motor-driven, gear-type pump with a discharge checkvalve that retards the drop in pressure in the system during temporary engine shutdown. A pressure regulating valve built into the injection pump holds system pressure to 20 psi.

This fuel injection system provides for automatic full or partial cut-off of fuel flow during deceleration.

(Briefed from a description given by C. H. Nystrom, assistant chief engineer, Fuel Injection Section, American Bosch Arma Corp., before Cleveland Section, Society of Automotive Engineers, Cleveland, Jan. 21, 1957.)

For more details on the Detroit SAE meeting held in January turn to p. 134.

WHEELER

McGREGOR

LOGWINUK

MADDOCKS

THORNTON

HAIG

FORTER

HARDCASTLE

BOCHOW

JONES

HOUSER

PETROLEUM PROCESSING tape recorded the last regional meeting of the Western Petroleum Refiners Ass'n in El Dorado, Ark. Here is the second series of technical tips on processing problems from the complete transcript (checked for accuracy by each speaker). Moderator of the panel of authorities that answered all questions was Harry K. Wheeler of Pan-Am Southern Corp., El Dorado, Ark. Members of the panel were: D. W. McGregor, Lummus Co.; Dr. A. K. Logwinuk, Houdry Process Corp.; R. R. Haig, Esso Research and Engineering Co.; A. A. Forter, Cities Service Refining Corp.; C. A. Hardcastle, Lion Oil Co.; Carl E. Bochow, Suntide Refining Co.; Bruce Jones, McMurrey Refining Co.; Mark E. Houser, Republic Oil Refining Co.; R. R. Maddocks, Blaw-Knox Co.; and D. P. Thornton, Jr., Universal Oil Products Co.

This month's technical tips on . . .

Catalytic Cracking Problems

? Maximum Regenerator Temperatures: To what current maximum temperature are regenerators now being operated? Does this maximum change if carbon steel cyclones are utilized? What are the design regenerator temperatures on new units?

Haig: We like to keep ours down to 1100°, if possible, to hold down after-burning. I'll admit that this can be a severe limit, especially when you are trying to expand the unit and you are up at maximum cat circulation rate. As we have just heard, burner temperature is going to start to climb and usually you tend to live with a higher temperature rather than take a loss in the feed rate or conversion. But as you go up above 1100° your chances of getting after-burning are definitely higher, so it means you have to control your excess oxygen more carefully at higher temperatures.

For the question, does this maximum change if carbon steel cyclones are utilized? Our units now are putting in 18-8 cyclones, primarily to avoid oxidation, rather than any problem of metal failure or warping caused by high temperatures. Once we have taken that route, where we have 18-8 cyclones and plenum chamber, and a lined vessel, then the matter of maximum temperature becomes a bit academic. You can go very high without much effect on metal strength. Certainly if you are using carbon steel cyclones, you want to keep your temperatures down, although 1100° is not necessarily the maximum. We set that more for prevention of after-burning than for failure of the metals in the unit.

For the question, what are the design regenerator temperatures on new units? There again, in effect, we used to use 1175° as a design temperature, but now that we have 18-8 materials it's not really a limiting factor.

? Regenerator Grid Erosion: What is the best grid design to minimize erosion? Is a 2-lb design pressure drop too high for a Model IV unit?

Haig

Haig: Right there I'll make a plug and say buy a Model IV unit, because we don't send any catalysts through the regenerator grid on the Model IV. We use a carbon steel grid and it runs at a low temperature. There is no catalyst going through it.

Is a 2-lb pressure drop too high for a Model IV?

Haig: Definitely not. We strongly recommend it for getting better regeneration. I think UOP published figures several years ago showing the effect of grid pressure drop on regeneration efficiency. I believe its recommendations are in the same 2-lb range.

If you're talking about the reactor side pressure drop, there the Model IV is more like other units, in that you do have a mixture of vapor and catalyst going through the grid. We still believe there is quite a large advantage in reactor efficiency in going up to a 2-lb pressure drop, and as far as I know, that is being used in all our units.

Now, there is a definite problem of erosion there. At this point we feel that the best way of getting around it is to put alloy inserts in the grid holes. I believe the metal that we have found most successful is an alloy known as Colmonoy. Unfortunately, I don't know what it is made of exactly. It does, of course, add a little bit of expense in building a grid and putting it together, but we found

that it is worth it because of increased reactor efficiency, and better distribution of incoming feed.

Wheeler

Wheeler: For those of you who don't have Model IV units, Mark Houser, will tell how the folks down at Republic licked this grid erosion problem.

Houser

Houser: We operate a UOP wartime unit. As you know, in this design the air and catalyst enter the regenerator through the grid. Several years ago we had serious erosion problems in the regeneration grid. We installed a capped and slotted extension on the riser, and have practically eliminated this problem. In order to save time, I will not go into details, but I have them if anyone is interested.

Mardaga (International Refineries): Are these 18-8 cyclones lined, Dick, or are they unlined?

Haig: I believe the primary stage is lined for erosion prevention; the secondary stage is unlined, because catalyst loading is very low. That's strictly a function of catalyst loading and gas velocity.

? Cracking Light Stocks: In considering catalytically cracking overall feed stock prepared in a refinery having a vacuum feed preparation facility, what is the available information to indicate the effects of including excess kerosine distillate in the feed stocks on (a) the amount of cracking affected in the kerosine distillate, and (b) the effect on octane numbers as compared to considering 100% "wash-through" of kerosine distillate?

Forter

Forter: We have not deliberately tried to cat crack any kerosine or distillates in that range. We have inadvertently included some in our feed stocks occasionally, because of manipulations of the primary unit. The effect is immediate. If you are interested in maintaining the quality of your cat gasoline, octane-wise, you had better keep it out. While there may be some cracking or reforming of the kerosine taking place, the octane member of the product is such that it will immediately depress that of your cat gasoline.

We try to keep the initial point on the light gas oil at a minimum of 475 if we can't get it even higher. We fractionate our cat gasoline into three cuts. The lighter cut is not too much influenced by the kerosine, but to illustrate how far the kerosine conversion has gone, the heavier and intermediate cuts are immediately affected octane-wise when there is any perceptible amount of stock below 475 initial, in the light gas oil coming off your primary unit.

And to the extent that you are affected, because I don't have the percentage of kerosine or that boiling range material, heavy kerosine, I can only say this: when the initial point on the feed stocks drops from 475 down to around 450 or 440, the octane on the heavy gasolines drops off 1½ numbers, and on intermediate as much as 1 number and even worse.

? FCC Gas Plant Corrosion Inhibitor: Is corrosion inhibitor being used in the FCC gas plant system? If so, where and how much?

Hardcastle

Hardcastle: In our vapor recovery plant we have experienced considerable corrosion in the deisobutanizer overhead condensers after two years of service. The Admiralty tubes, the steel cross baffles, and the shell were attacked severely. We looked into this situation and after investigating several inhibitors, we decided that one dispersable in water would be more suitable for our use at this point, because the system was essentially dry, and we wanted to inject water into the system so we would have a control point.

We mixed the inhibitor with water, a ratio of 10 to 1 by volume, and agitated with air to keep it dispersed. Then, with a proportioning pump we put the inhibitor into the overhead vapor line at the rate of 10 parts per million, and the material passed through the condensers and into the reflux accumulator. We withdrew water from that point to check the iron content, and in about three weeks we were able to reduce the iron from about 1500 ppm to 100 ppm.

? Raising Feed Preheat: What is the effect of preheating the feed to the FCC converter to 400°F and 750°F on (a) coke lay-down; (b) catalyst circulation; (c) regenerator heat removal; (d) product distributions.

Maddocks

Maddocks: I can think of only two situations where anyone would want to increase his feed preheat. The first would be for a unit operating at maximum carbon-burning rate, where it is desired to increase the total feed rate without lowering reactor temperature. Secondly would be a unit running at maximum carbon-burning rate, where increased reactor temperature is wanted.

The first effects of increased preheat, are reduced catalyst circulation and higher regenerator temperature, corresponding to the lessened heat required by the reactor from the regenerator, in order to hold a constant reaction temperature. The lower catalyst circulation causes a drop in conversion, which results in less carbon production.

As the carbon level falls, burning rate, and therefore heat released, also falls, so that regenerator temperature comes back down somewhat. To sum it all up, the net effects of increasing feed preheat while maintaining a constant reactor temperature, would be a decrease in carbon production and carbon level on catalyst. The carbon burning rate would drop while the oxygen content of the flue gas increased. The regenerator temperature

would be about the same, and catalyst circulation would fall off slightly.

Logwinuk

Logwinuk: In moving bed units, we are generally not faced with this problem, because of the long path of feed travel through the catalyst bed. However, there have been some indications in the industry, in both moving bed and fluid cracking units, that the benefit of raising feed temperatures from 400°F to say 750°F may come from better stripping of the catalyst at the elevated temperatures.

Better stripping, particularly of the heavier feeds from the catalyst would, of course, lower the quantity of feed occluded on the existing catalyst and available for destruction in the regenerator. As a result, lower coke and higher product yields may be expected. When this occurs, the catalyst circulation may be decreased.

Because less feed is burned in the regenerator, regenerator heat removal is also decreased.

I would not expect increased feed temperatures to have any significant effect upon product distribution, provided, of course, that the reactor temperature is kept at a constant level. To reiterate, however, the product yields may be expected to increase by the amount of hydrocarbon that is not included with the catalyst reaching the regenerator.

Eppard (D-X Sunray): We've recently added a second preheater to our FCCU at Duncan to increase our charge preheat. Before the new heater was installed we were operating with a combined feed temperature to the reactors of 550°F and since the new heater was put on stream we've raised our combined feed temperature to 660°F to 670°F. Our data shows that by increasing the feed temperature from 550°F to 660°F we have increased the conversion 1% at the same weight-% coke. In addition, we have noticed that when we lower our feed preheat, the regenerator temperature rises, indicating that as feed temperature decreases, coke yield rises.

Wheeler: Did any of the other things change? Any other product distribution or octane changes?

Eppard: We have not been able to detect any other changes in product distribution for this increase in feed preheat from 550°F to 660°F.

? Product Distributions: What are the comparative product distributions when cracking virgin, cracked, and coker gas oils?

Logwinuk: I have some data on cracking of Kuwait virgin and coker stocks but not for cracked Kuwait gas oil. However, because cracked gas oil properties and qualities as a cracking charge stock are in between virgin and coker, we may expect the results for cracking a cracked gas oil to fall somewhere between virgin and coker.

When cracking to the same severity and at essentially the same conditions, virgin stocks yield approximately 25% more C_5 to 400°F gasoline than a coker charge. Coker, on the other hand, lays down about 60% more coke. Butane yields with both stocks remain about the same; but coker gives about 25% more dry gas.

McGregor

McGregor: I have some figures that confirm more or less what Alex has said. I know of one refiner who has tried to analyze what he is going to get with his coker gas oil. With the same condition of cracking a virgin gas oil, the coker gas oil will give about 80% yield of the virgin gas oil or reduce the gasoline about 20%. In the range of a 50% yield at 80% efficiency, the coker gas oil would produce about twice as much coke, C_2 and lighter material; 1½ times as much C_3's; and about 1.1 times as much C_4's. But these will vary with the material balance.

This is all at constant conversion. At higher conversion you will still get about 80% gasoline yield on coker gas oil, and the other materials will be reduced according to material balance. This refiner has never run specifically all coker gas oil to get these results, but rather a mixture of coker gas oil and virgin gas oil. This was a correlation of different runs.

Jones

Jones: Is there any correlation with carbon residue? What I'm interested in principally, is what might be the range of the con-carbon on this coker gas oil? Our coker gas oil runs about 0.11-0.12 con-carbon content. It is actually coker and virgin gas oil combined, and I was simply wondering about your data.

McGregor: I don't have any data on that.

Wheeler: I think it's established that the con-carbon on coker gas oil doesn't necessarily have to be higher than the virgin. It might be slightly higher, but you can make a pretty clean coker gas oil.

Norris (Houdry): We've found that this holds true with relatively clean gas oil—up to 2 or 3 tenths con-carbon.

? Cracking Heavy Recycle Gas Oil: Are there any advantages to operating blocked out on virgin and heavy recycle gas oils? What would be the difficulties? Would the answer be different if the recycle gas oil were hydrogenated? How do hydrogenated and raw gas oil yields compare?

Logwinuk: The consensus of opinion for blocked out operation varies, even within the same organization. In my opinion, there is no particular advantage, and the same results may be expected. There should be no difficulties in blocked out operation.

Hydrogenation of a recycle gas oil would give a difference in results. Comparing a hydrogenated or treated gas oil to an untreated gas oil, we can expect about 10% less propane-propylene, 10% more butane-butylene, about 6% more C_5 to 400°F gasoline and about 26% less coke laydown for the treated stock. These results are, of course, at the same conversion level. Assuming that the cracker is limited by coke burning capacity, hydrogenation of the

recycle stream would permit a 35% increase in throughput to bring the regenerator up to 100% of capacity.

Simultaneously, with these benefits, sulfur is removed, thus increasing the lead susceptibility of the produce gasoline. For example, the leaded octane may be increased from 97 to 99.5. The unleaded clear octane remains at about the same level, i.e., 92-92½.

Haig: Our studies confirm what Alex has said, at least as far as coke and naphtha go. Taking it further, what you usually do in a plant is come back to constant carbon burning rate by increasing conversion or feed rate, and we come up with something like 3% more naphtha on the feed and the same amount of heating oil, even though the conversion is higher.

In hydrogenating a recycle stock, we have got credits as of much as 40¢ to 60¢/bbl. I think the study we did very recently for Bill Mardaga (International Refineries) on hydrogenating their cat feed, came out about 52¢/bbl credit. That sounds terrific, but don't forget we can't do this for free. Hydrogenation costs money, and there are valuable alternate uses for hydrogen. These are credits that are worth looking at.

? Blending Cat Cracked Gasolines: Catalytically cracked gasolines from different catalysts vary significantly in their octane blending values, depending upon the catalyst used and base stock into which they are blended. Give the available information on this subject for: (a) DB light catalytic cracked (200-250 EP) gasoline, (b) DB total catalytic cracked gasoline, in each: (1) Catalytic reformate and (2) In over-all pool gasoline.

Wheeler: Nobody knows anything about it, but a lot of people have started to do something about it. However, it was jokingly said this morning that maybe we had better tell the fellow who asked this question that he is not going to be able to blend his cat base stock into his reformate very much longer. Cat base stock is too low in octane to go into premium gasoline. We don't have any answer on that one.

? Diluting Reactor Feed: Has anyone tried, after getting into high carbon, using a diluent in the FCC reactor feed to get out of that high carbon? Not momentary, but at least a short term usage of some type of diluent that will actually take up the heat in the heat of vaporization or something like that, rather than lay down a lot of coke.

Woodside (Bell Oil & Gas Co.): I will say that we keep a line available at all times for this diluent you are talking about—usually kerosine. It is hooked into the charge line, and it is available from a large storage, so you can use it any time if you feel you are high on carbon. It will help.

Forter: We have three units. One that we call our heavy oil unit. When carbon resid on feed gets up to the extent that we can tell she's getting loaded, then we do what we call "sweeten up." However, we don't use kerosine. We use light virgin gas oil, or cat recycle, gas oil. I have a young man sitting back there who might elaborate on that. Mr. Farrier, would you get up to the microphone and say something about this?

Farrier (Cities Service Refining Corp.): We use about 16,000 bbl of light gas oil out of total feed of about 40,000 on the unit, of which about 10,000 is deasphalted gas oil and the balance usually vacuum heavy gas oil. We got into trouble once on our B-cat unit. We had a lot of carbon on cats and we used virgin light to help us on that, too.

Haig: I assume we've been talking about occasional carbon build-up. There, your big problem is to absorb the heat from the unit without depositing any more carbon. If you just cut your feed out entirely and throw in a naphtha stream it is the best thing you can use. Don't send it into a cat naphtha product tank, of course. Several of our units do have a line on them so that naphtha can be injected in an emergency.

Park (Pure Oil): How light a feed do you recommend; something in the upper gasoline or heavy naphtha range?

Haig: A heavy naphtha of some sort. You're not trying to make anything out of it. You're just trying to absorb heat, to get rid of the coke quickly. It's easier than using steam or something like that, because you can avoid the big heat load in your condenser. It's drastic, but effective.

Park: Did it foul up your fractionator so that it took quite awhile to get back in balance on your gas recovery system?

Haig: I couldn't tell you in detail. It certainly would upset it, no question about that.

Mardaga: We had a very severe carbon build-up, about a year ago. We lightened up the feed and the unit ran along for awhile with no appreciable improvement. We got the impression that the tremendous amount of carbon on the catalyst was absorbing so much of this oil that any headway we were making was awfully slight, so we finally pulled all the feed out of the reactor, and within about 10 hours had it off.

We have found the added carbon on the cat acts sort of as absorbent, and just carries that much more oil into the regenerator, and cuts down your rate of carbon burn-off. We had, of course, quite an upset. I suppose what we did would compare to putting naphtha in the unit instead of feed and that is just like a shut down and a start-up—no easy way to do it.

Haig: You can get out of it without putting the naphtha in, that's true, but it takes you a lot longer because you can't burn off the carbon as fast. The value of putting in naphtha or something to absorb heat is that you can circulate faster, and you burn off your carbon a lot faster.

Mardaga: I think that's right. We had to watch the reactor temperature. It went up to 1,000 or 1,050 for four or five hours, but we had no naphtha available, so that was all we could do.

? Regenerator Linings: What regenerator lining is now felt to be the most satisfactory? If hex steel is used, is alloy better than carbon steel?

Haig: I think we are pretty much going along with general industry practice in using a monolithic lining with the hex steel to hold it in place. One thing we have done with

our regenerators is to go to alloy hex steel instead of carbon steel, and we've found that the life is considerably longer. It is the same problem we ran into in the cyclones —the same reason we went 18-8 on those—oxidation. As our older units with carbon and hex steel in them wear out or become oxidized, we replace them with 18-8. I believe Foster-Wheeler published a study of regenerator linings; someone referred me to it this morning.

? Effect of Catalyst Particle Size: What is the commercial experience on the effect of catalyst particle size, in terms of average particle size or percentage through a given screen size, on catalyst regeneration?

Houser: I can cite some experience that we had a few years ago. Because of worn out catalyst recovery equipment, we got into serious regeneration problems. At that time we found that our percent through 270 mesh, which is approximately 55 microns, had dropped to less than 50%. In other words, we found in our particular unit, that unless we kept the percent through 270 mesh above 50%, we had regeneration difficulties.

? Using Recycle to Increase Gasoline Yield: What is the magnitude of increased gasoline yield from substituting recycle for space velocity, holding conversion and other operating variables constant, in the 65-70% conversion rate?

Logwinuk: I have some data on East Texas gas oil, which was cracked over a bead catalyst at 70% conversion and 900°F. The data is for zero recycle, 0.5 to 1, and 1 to 1. The C_5 plus production increases 6% and 12% for the 0.5 to 1 and 1 to 1 recycles over the non-recycle case. The C_4 production decreases by 6% and 12%. Dry gas is decreased by 8% and 15%, and coke is decreased by 10% and 20%.

? Handling Light Cracked Distillate: What measures are other folks using in handling FCC light cracked distillate? That is, besides something like putting it to fuel, or to thermal cracking. Has anyone tried actually cracking light cracked distillate—well, almost to extinction? That is, in the range of just a lighter cut than the heavy gas oil recycle. Most people, I think, recycle heavy gas oil to extinction. Well, what about the light gas oils themselves? Has it become necessary to just hydrogenate these, or just exactly what steps are other folks taking to get rid of that excess light gas oil?

Jones: We don't crack 100% light cycle, but it is a mixture of light and heavy catalytic cycle stocks. It would run about 60%, maybe 70%, light cycle with the balance heavy cycle, and it is charged to our Dubbs 2-coil thermal cracking unit. We run about 300 lb reactor pressure, and 1025 to 1030°F on the light oil coil transfer and about 910°F on the heavy oil coil transfer. We have run down to API gravities on the fuel oil, (making carbon black stock for manufacturers of furnace black) between zero and 2° API. Our thermal operation is a blocked operation with us. We run the thermal cracking unit under at least two and sometimes three different operations during a month and this represents one of them.

Wheeler: What temperature and pressure conditions do you crack that under?

Jones: It is about 1025-1030°F on the light oil coil, and 910°F on the heavy oil coil at 300 lb pressure.

Needless to say, the capacity of the unit is reduced considerably under this operation, but we do get a premium for this carbon-black stock. Because we are not able to economically dispose of all of our light cycle, in diesel fuels, etc. we have to thermally crack some of it.

? Dry Gas and Butane Distribution: What is the effect on dry gas and butane distribution of the following operating variables: a—temperature; b—catalyst oil ratio; c—space velocity.

Haig: This question asks the effects of temperature, catalyst-oil ratio and space velocity. Of course, if you change any one of those by itself to increase conversion, you naturally are going to increase your gas yield and probably your C_4 yield.

Assuming, though, that this question means at constant conversion, what's the effect of changing these? For the first one—temperature—I think its general effect is to raise the amount of dry gas and also to increase the unsaturation in the C_3 portion of the dry gas. We've never found much effect on unsaturation in the C_2 cut; it usually runs on the order of 40% in our experience. On the C_3 cut, it can vary anywhere from 50% unsats on up to 80 and beyond, as your temperature increases.

The catalyst-oil ratio, again at constant conversion—I don't know of any definite effect there, on either the gas or C_4 cut.

To go back to that first item, temperature. This effect of increasing unsaturation also shows up in the butane-butylene cut. Space velocity is the same thing. As long as your conversion is held the same—in other words increase space velocity and cut back on some other variable to hold conversion constant—you wouldn't expect to find much in the way of change in the dry gas and butane distribution.

Mardaga (International Refineries): Has anyone had any experience on feed coils in the regenerator?

Bochow: I believe I have heard some comments on that and the people who have commented have seemed extremely reluctant to try that sort of installation—the coking problem may be very serious. Are you talking about putting your gas-oil through the regenerator first?

Mardaga: Yes.

Bochow: It sounds like a nice idea, but I think that you might run into a very serious coking problem at those temperatures.

Haig: The old Model I units had feed exchangers that were external to the regenerator. After about 10 years we finally got rid of them all as a safety measure. Those were the things that leaked and caught fire most often. Now we couldn't begin to get them in because the safety department is determined to keep them out.

Going Into Radioactivity?

By ROBERT G. GALLAGHAR, health physicist
Liberty Mutual Insurance Co.

IT'S HARD to find a segment of American industry that isn't using atomic energy in the form of radioisotopes or radiation-producing equipment.

New industrial applications are being discovered at a surprising rate. Nearly 2000 firms are now licensed to use artificial radioisotopes under the Atomic Energy Commission's Byproduct Materials Program (as of Feb., 1956.) Of these, 59 are oil companies. They are in the field because their managements are convinced radiation offers a better way to do certain jobs, or can be used as a tool to learn something new.

Last year alone, the oil industry saved an estimated $10,000,000 with radiation. A single petroleum processor reports that he saved $40,000 in one year because radioisotopes showed him how to optimize his cracking operation. Refiners are among the leaders in exploiting the opportunities in radiation for cheaper operations and better products.

But finding the best applications is just the first step in launching a radiation program. You soon come up against questions of safety, insurance, employe and public relations, and a host of other things. They can be knotty, but every management must know where it stands with regard to them before it can cash in on the benefits of radiation.

1 How much will it cost to have a safe project?

This must largely depend on what applications you pick. For level gages or tracers the cost of a program is likely to be very low. If you want to study radiation's affect on chemicals—which means reactors or particle accelerators—the cost will be greater.

In many cases, an adequate radiological safety program includes employe education, public information, medical controls, as well as safety equipment. These things must not be considered "additional" expenses. A necessary part of your radiation program is the part that guarantees it will be done safely. Management must accept full responsibility for the protection of the public and employes. This is your first premise, and it is essential. What's more, a carefully planned program is an important foundation for your future expansion in this field.

Cost of radiation safety is lower for industry than it would be, because of the valuable ground-breaking done by the AEC. Today the Commission spends $100/man/year for protection and several million dollars a year for research and safety. Much of the AEC's vast experience in radiation safety is at the disposal of industry. Handbooks for guidance in these matters are available from certain federal and state agencies. A few of the more pertinent references are on p. 72.

2 How will safety laws affect your plans?

You should have no trouble if your radiological program has been properly planned and put into operation. But you should know what regulations exist and what the trends are in legislation. Certain federal agencies and a few states have specific legislation, i.e., laws that detail necessary safety procedures. Most of the states have enabling legislation; this merely gives officials broad authority to require certain minimum safety standards, stated in general terms. A few states have no radiation safety laws as yet.

The overall trend in the radiation field shows the federal government will relinquish some of its power to regulate health and safety to the states as soon as the latter have laws adequate to safeguard the public welfare. Some states are planning now to modernize their radiation safety laws, possibly because of the recent concern over the effects of long-term radiation exposure.

This new legislation is likely to do five things:

1—Specify maximum permissible dosage of radiation for employes of radiation users and for the public. This will probably be set at currently acceptable levels.

2—Declare that the responsibility for control of radiation exposure lies with the user and his employer.

3—Require radiation dosage monitoring and surveys.

4—Require users to identify radiation hazards with standard warnings and symbols.

5—Make it mandatory to keep certain records concerning a user's medical control measures, radiation monitoring, and surveys.

The new safety requirements of the states will probably be consistent with each other—at least in principle—because most of them are being based

Answer These Nine Questions First

on two sources: (1) reports of the National Committee on Radiation Protection, in handbooks published by the National Bureau of Standards (the Committee is sponsored by the Bureau), and (2) the AEC's "Standards for Protection Against Radiation." Some states have extended the scope of these standards to include other radiation hazards such as X-rays and radium. In addition the basic requirements of the Interstate Commerce Commission are included in some of these state laws.

Many states have personnel in their health or labor departments who can help the potential radiation user. You should tell these people about your plans, especially if the project is likely to be in the public eye.

At present, the AEC has the most extensive control in the atomic energy field. Everyone who wants to build a radiation facility or use radiation sources must have an AEC license. Even if you get your radiation source from a supplier rather than directly from the government you must have a license, although your supplier can be helpful in obtaining it.

This screening of applicants is one reason for the excellent safety record in use of AEC controlled radioisotopes. In general, the AEC wants evidence that the applicant's facilities and equipment are adequate for safety and that he is qualified by training or experience to use the material safely. But again, real protection depends on the safety awareness of management, not a set of laws or regulations. No one can legislate a safe attitude.

There are unsolved legal problems that might affect your activities in the atomic energy field. One is manufacturer's product liability. This affects the user's relations with the suppliers of instrumentation and equipment. As it stands today a damage suit for equipment failure against the supplier does not turn entirely on the question of his possible negligence. Although clear precedents do not exist for radiation cases, indications are that the supplier is liable despite his use of all possible care. This could be disastrous for a small supplier. The issue will probably be clarified in the future.

Workmen's compensation acts are another problem. Many present-day compensation laws offer no protection for the employe who shows symptoms of radiation damage after expiration of the statute of limitations—in some states as brief as six months after an accident. We can expect this to be liberalized to take account of the longer time lapse in radiation injuries. Until then, you would be wise to be conservative so far as employe exposure to radiation is concerned. Insist on close adherence to the best available radiological procedures. What's more, it may prove extremely valuable to document your effort in behalf of radiation safety.

3 What special safety training is needed?

Again, this depends on the application you plan. Where the source you want to use is entirely enclosed—a liquid-level gage, for instance—no special education is needed for employes. The supplier will provide and install the apparatus, and he will also show your personnel how to use it. Furthermore, he will repair and maintain the equipment, and your worries will be few. Going only this far into radiation naturally avoids some of the complicated problems. But at the same time you miss the experience and benefits to be gained from broader use of this new tool.

If you want to use unsealed sources (tracers, for instance) or large quantities of material, you will need a man trained to handle them. In fact, he needs *experience* as well as training. The training he must have is specified by the AEC and by some of the state laws. Among other things, he's got to know

1—Radiological health safety—principles and practices.

2—Standard ways of measuring radioactivity, how monitoring is done, and how the instruments are operated.

3—Mathematics and calculations basic to the use and measurement of radioactivity.

4—Biological effects of radiation.

Finally, he needs actual experience with radioactive materials of the type and in the quantities the company wants to use.

Where training courses are offered in the field of radiation

Training in radiological and health physics

University of Buffalo
University of Cincinnati
University of Chicago
Columbia University
Harvard University
University of Illinois
State University of Iowa
University of Kansas
University of Michigan
Massachusetts Institute of Technology
New York University
University of Pennsylvania
University of Pittsburgh
University of Rochester
University of Utah
Vanderbilt University
University of Washington
Washington University
Argonne National Laboratory
Brookhaven National Laboratory
Oak Ridge Institute of Nuclear Studies
Sanitary Engineering Center (U.S. Public Health Service)

Special courses in isotope techniques

Howard University
University of Kansas
University of Kentucky
University of Michigan
University of Oklahoma
Purdue University
University of Rochester
Rutgers University
University of South Carolina
University of Tennessee
University of Texas
Argonne National Laboratory
Brookhaven National Laboratory
Oak Ridge Institute of Nuclear Studies

4 How and where can this training be obtained?

It's relatively easy to obtain the necessary training in certain parts of the country. Courses are being given by the AEC, suppliers of radiation sources, universities, and some public health agencies.

First on the scene was the AEC, which trains people in both industrial and medical uses of radioisotopes at the Oak Ridge Institute of Nuclear Studies. These are two-week courses.

The commission has also helped set up training by universities and non-governmental organizations in various parts of the country. The U. S. Public Health Service offers short-courses for public health personnel and others at the Sanitary Engineering Center in Cincinnati. Tracerlab, Inc., a private company, offers instruction both in Boston and Berkeley, Calif. Certain industrial associations and other concerns also provide such training.

Training given by the AEC and public health organizations is free. The academic background required for these courses is generally very reasonable, depending on the specific courses. Fees for the privately run courses begin at about $50.

A number of colleges and universities have offered special courses of instruction in this field. Specific details on current and future courses or special training should be obtained directly from the school. You can also obtain information by contacting the AEC Division of Civilian Applications or your state health department.

5 How will a radiation project affect insurance?

Some people have felt that obtaining adequate coverage for a radiation facility would present a great problem. This is not entirely true—some well-managed radioisotope and radiation installations have been insured for years with no unusual "loading" of the premium. There *is* an insurance problem when several hundred million dollars of insurance coverage is requested for something claimed to be safe, though it is obviously very new both to industry and to the insurance companies.

One difficulty for the insurance companies is that, for the large-scale nuclear reactor applications at least, there is too little accurate information on what might go wrong and what consequences would follow.

Offsetting this is the exceptionally good record to date in industry's use of radioisotopes. This is largely because of the AEC's screening of license applicants and the control it exerts over users. It is in direct contrast to industry's experience with radium, thorium and X-rays in the early part of this century. Unfortunately, the same types of injuries from unsupervised use of X-ray and radium continue to be reported, but as yet the author knows of no serious injury resulting from the misuse of AEC licensed radioisotopes.

In any case, management must be sure that the liability the company will have to assume in the event of a mishap does not jeopardize its capital structure.

In figuring the coverage needed, management should assess these five risks:

1—Damage to capital equipment, such as machinery. Contamination by a spill or spread of unsealed radioisotopes is possible, but good design of radiation facilities will minimize this risk. Some equipment leasing contracts may contain clauses regarding radioactive contamination, so review these contracts to assess your liability. If you provide enough space for the work, enough shielding, and well-trained and supervised workmen, the danger of radioactive contamination is greatly reduced. Investigate your insurance policy to determine whether radioactive contamination that might occur with your project is included in your coverage.

2—Contamination of buildings or other facilities. The company could lose quite a bit of money if buildings or facilities had to be vacated for as long as it takes to clean them of radioactivity by specially trained crews. Or radiation might make it necessary to discard certain equipment. In one industrial radioisotope accident, the loss from both of these causes exceeded $250,000. But trained personnel and adequate safety procedures make this sort of danger extremely remote, and coverage should be no problem. Where "Use and Occupancy" coverage already exists in a company's policy there probably will not be an additional charge for radioactive contamination, providing only radioisotopes are being used, not a nuclear reactor.

3—Damage to product. This is extremely unlikely in petroleum processing, where there are such effective mechanisms available for controlling any of the radioactive material that might enter the process. Design of equipment and trained personnel will again minimize this danger.

4—Injury to personnel. Workmen's compensation can be obtained without difficulty, and in most cases without unusual rates, *if* management insists that employes follow the well-established radiological safety practices. Frequent surveys of protection equipment and procedures by the company and outside groups will further decrease risks.

5—Damage to the public. This is the most difficult coverage to obtain in adequate amounts, particularly in the case of nuclear reactors or whenever a company's use of radiation may be thought to involve considerable hazard to the public. It may require more coverage than one company, or several together, can legally write. So, the insurance companies may not be able to underwrite this project beyond certain maximum limits.

For this reason some of the insurance companies have formed syndicates or "pools" to underwrite the extremely high coverage desired for nuclear reactors. Many of the stock and mutual companies have cooperated along with foreign reinsurance markets in an effort to meet the needs of nuclear industry. Coverage for public liability is now available in the U. S. insurance market to the extent of about $50,000,000 for each reactor. In the present session, Congress is expected to act on a proposal that would authorize the government to indemnify private operators of reactors and their suppliers. The government would supplement insurance

Where atomic energy legislation stands today

(for states not listed, see note below)

Official agency	Status of legislation	Sets MPD*	Requires: Medical super.	Requires: Licensing notification or registration	Remarks
US Atomic Energy Commission	Specific**—limited	X	X	X	Covers only those radioisotopes under AEC jurisdiction.
US Interstate Commerce Commission	Specific	X		X	Applies to all radioactive mat'l.
US Post Office Dept.	Specific	X		X	Applies to all radioactive mat'l, established to protect photographic film.
US Civil Aeronautic Authority	Specific	X		X	Applies to all radioactive mat'l, some airlines have stringent requirements.
US Coast Guard	———	—		—	Revising their regulations.
Arkansas	Broad***	No	X	—	Requires medical exams, warning signs, periodical instructions.
California	Specific	X	X	—	Requires competent technical supervision, hazard training and permanent records.
Colorado	Broad regulations	X	—	—	
Connecticut	Broad regulations	X	—	—	
Delaware	Broad regulations	—	—	X	Health permit required for injurious amounts. Regulations do not apply to hospitals, clinics, physician's offices, etc., where there is complete control.
Florida	Broad	X	X	—	Requires inspection by Division of Industrial Hygiene.
Georgia	None	—	—	—	Two counties have regulations and have established MPD's.
Idaho	Specific—limited	X	—	—	For X-ray shoe-fitting only.
Illinois	Studying needs	—	—	—	Have radiological health unit.
Indiana	Specific—limited	X	—	—	For X-ray shoe-fitting only.
Kentucky	Pending	X	—	—	
Massachusetts	Broad—studying needs for additional legislation	—	—	—	
Michigan	None yet	—	—	—	Health dept applying existing public health laws to radiation use. Study group recommends adopting AEC regulations.
Missouri	Broad	—	—	—	Governor failed to submit Bar Ass'n proposed atomic energy act to general assembly.
New Jersey	Specific	X	X	X	Applies to all radiation use—follows AEC, ICC and NBS requirement.
New Mexico	Broad—studying needs for specifics	—	—	—	Health Dept authorized to control public health aspects of radiation.
New York	Specific—2 acts	X	X	X	Labor & Health Dept acts cover all radiation, follows AEC, ICC, NBS.
Ohio	Broad	X	—	—	Uses old MPD (0.5 roentgen/wk).
Oregon	Broad—studying needs	X	—	—	
Pennsylvania	Pending	X	—	—	Adapted from NBS Handbook 61.
Texas	Specific	X	X	X	Follows AEC and NBS recommendations and applies to all radiation.
Utah	Specific—limited	X	—	—	
West Virginia	Broad	X	—	—	
Wisconsin	Broad	X	—	—	
Wyoming	Broad	—	—	X	Apparently applies only to radioisotopes.

NOTE: States not listed herewith have no legislation at all. Of these, the following have reported they are studying needs: Maine, New Hampshire, Rhode Island, South Carolina, Vermont.

*MPD is Maximum Permissible Dosage.

**Specific—sets down detailed requirements, may or may not include all forms of ionizing radiation.

***Broad—usually gives general authority to officials to make sure certain safety criteria are adhered to.

from private firms and bring maximum coverage available from both sources to $500,000,000.

But these difficulties apply only to the users of radiation on the largest scale. For most firms, insurance companies will be able to add coverage to their policies, providing their radiation applications are properly engineered and supervised. This is one of the places where your effective radiation safety program will pay off.

When the insurance company's specially trained investigators are evaluating a company's radiation risks, they look at such things as:

- The type and amount of radioactive material the company will be using.
- The half-life (i.e., rate of disintegration) and energy of the

Where to get more information on industrial uses of radiation and radioisotopes

Government pamphlets: Order these direct from the Superintendent of Documents, Washington 25, D.C.

1—"Safe Handling of Radioactive Isotopes," National Bureau of Standards, Handbook 42, $0.20.

2—"Control and Removal of Radioactive Contamination in Laboratories," National Bureau of Standards, Handbook 48, $0.15.

3—"Radiological Monitoring Methods and Instruments," National Bureau of Standards, Handbook 51.

4—"Protection Against Radiation from Radium, Cobalt-60, and Cesium-137," National Bureau of Standards, Handbook 54.

5—"Permissible Dosage from External Sources of Ionizing Radiation," National Bureau of Standards, Handbook 59.

6—"Regulation of Radiation Exposure by Legislative Means," National Bureau of Standards, Handbook 61, $0.25.

7—"Radiation Hazards in Firefighting," Safety & Fire Protection Technical Bulletin No. 4, U.S. Atomic Energy Commission, $0.35.

8—"Selected Readings on Atomic Energy," U.S. Printing Office, $0.25.

AEC booklets: address requests to US Atomic Energy Commission, Isotopes Division, Oak Ridge, Tenn.

1—Part 20, "Standards for Protection Against Radiation," Part 20, Title 10, Chapter 1, Code of Federal Regulations. (A compilation of these regulations is available from USAEC Isotopes Division on request).

2—"Radioisotopes—Uses—Hazards—Controls," USAEC Isotopes Division, July, 1954.

3—"Some Practical Considerations in Radiation Shielding," Circular B-4, G. W. Morgan, USAEC Isotopes Division, 1948.

Associations, magazines, miscellany:

1—"Physical, Biological, and Administrative Problems Associated with the Transportation of Radioactive Substances," R. D. Evans, Publication 205, National Research Council of the National Academy of Sciences, Washington, D.C. (1951).

2—"Radiation Hazards of Radioactive Isotopes in Fire Emergencies," International Association of Fire Chiefs, 22 East 38th St., New York 16, N.Y.

3—"The Atom on Film—A List of Available Films," Atomic Industrial Forum, Inc., 3 East 54th St., New York City. The list shows a total of 33 popular-level films, and 18 professional-level films available from business firms, governmental agencies, and institutions—some on a loan basis and some for sale. In addition, the AEC has made available some 110,000 ft of unedited 35 mm black and white film footage without sound track covering unclassified aspects of AEC and contractor research and operations in 13 installations throughout the nation. These materials are uncompleted motion pictures for general showing and are not for loan. They are being distributed at standard Government cost rates (about 10¢/ft) through a Government depository. Contact Atomic Industrial Forum, Inc., for information.

4—"Radiation Protection in the Atomic Energy Industry," H. M. Parker, *Radiology*, Vol. 65, p. 903, December, 1955.

5—"Facilities and Equipment for Isotope Program," G. W. Morgan, *Hospitals*, March, 1955.

6—"Sourcebook on Atomic Energy," S. Glasstone, D. Van Nostrand Publishing Co., New York City, 546 pp., $3.75.

radiation emitted by the material.

- Whether the material will be sealed or not and where it will be used and stored.
- The number of employes likely to be exposed to radiation (below dangerous levels).
- The likelihood of the public's being exposed.
- Degree of supervision over the use of the material.
- Training and experience of the personnel handling radioactive materials.
- The adequacy of the health safety and medical programs.
- Adequacy of the program of employe education in radiation.

You can use this as a check-list when evaluating the potential risks of your company's radiation project.

6 What should you tell employes?

This is probably the most important problem for a firm starting to use radiation and the one they are most likely to underestimate.

An education program is necessary to take the fear out of radiation work as well as to make certain each employe knows and can stick to the ground rules. He should know how to behave during routine radiation work and especially how to act under emergency conditions. One of the first things he should learn is the significance of radiation warning symbols —how to evaluate the danger.

Education should continue once the work is under way. This is the best way to sustain employe vigilance. Not every employe has to be made an expert, but all should have an idea of what is going on and what the risks are. Remember, every employe becomes a radiation expert in the eyes of his family or neighbors. He has to know enough to answer their questions factually.

Actually the program starts with management itself. The people who initiate the radiation project are the first who must be sold on the benefits and reassured as to its hazards. They must be prepared to meet inquiries from people at lower levels. They shouldn't have to learn the facts as the result of a scare or labor problem over the danger of radiation. The only proven method of combating "the big scare" is to provide facts before rumors are generated.

The educational program for employes and management should contain information about how other people are using large amounts of radioactive materials in safety, and how easy it is to do this. The techniques themselves are easy enough to understand. You can obtain pamphlets, movies and even comic books specially prepared to do this job. When the AEC, the state, or insurance carriers check the plant and find it safe for the applications you plan, tell your people. In fact, inspections of your program by outsiders both before and during the use of radiation are an excellent way to reassure people that their welfare is being considered.

One thing this education program must do is find the few people in your organization who have an abnormal

fear of radiation. It may be difficult to locate them, but when you do, spend some time with them on a strictly personal basis. Try to solve their fears. The medical control program can also assist in finding these people and putting the problem in its proper perspective.

Your continuing education effort should be aimed at improving safety practices and increasing the radiation workers' knowledge of safety. This latter point is important because it's reasonable to expect that new applications for radiation will turn up in time, and there will be a need for informed and responsible workers to handle them.

7 What should you tell the general public?

Be careful how the community learns of your radiation activities. You want to make it clear that your company fully understands the problem of protecting both employes and the public. News releases from your company must be carefully written after consultation with someone who knows the facts. Above all, you don't want the public to find out about your radiation work by rumor or by an unfactual news item, which is likely to be greatly distorted when the radiation "angle" becomes known.

Accurate news releases, guest speakers for town groups, plant tours, and special reports to local technical societies are ways of informing the community. You should begin this soon after employe education is underway.

Not only must your company publicize its intentions in the community, you should also take care to cooperate fully with city officials. Bring them into your planning at an early stage and you'll avoid a lot of trouble.

A large-scale user of radioisotopes ran into this sort of difficulty recently. When a new building was constructed, the planners failed to check with the city sewer department. After the waste disposal system had been installed—with a special design on the outside for easy maintenance—the sewer inspector discovered it and wanted it placed under the concrete floor for additional radiation shielding. The waste was actually free of radioactivity but the company had not gained his confidence beforehand. The project was delayed and considerable money had to be spent.

8 How are employes protected from radiation?

This is part of what is known as the field of "health-physics." It includes safety administration and organization, medical facilities, safety equipment and procedures, and related subjects—a large area. Let's discuss some of the major points.

The first thing you must do about safety is to make one person responsible for your safety program. He will probably be known as a "radiological safety officer," "radiation hygienist," "health physicist." See that he receives thorough training and appropriate authority. He should be responsible only to top management. He must have the proper information and equipment before any radioactive material is shipped into the plant. At all times his job is to know the location of all sources, who is using them, and what hazards there are.

Train this man first, then let him train the other radiation workers. The radiation safety officer should also function as a member of a closely coordinated public information team. He should work with the writer of news releases and the technical man who is supervising the entire radiation project.

Now, how are the workers protected? Generally speaking—in three ways:

1—By limiting the time they are near the source.

2—By keeping a distance from the source.

3—By staying behind shielding constructed around the source (e.g., water, lead, concrete).

Personnel monitoring devices are used to measure the intensity of radiation the worker is exposed to. Film badges, pocket dosimeters and ring dosimeters are among the more familiar devices of this kind. But they don't show what radiation he may have taken internally—by inhalation, for instance. This is indicated by various air monitoring devices and by area radiation surveys.

It is important regularly to check the evidence supplied by personnel monitoring devices. Investigate all high dosages, even when they are below the maximum permissible for safety. You may reveal relaxation of safety procedures in this way, or even an exposed source where one shouldn't be.

One thing to understand about radiation-measuring instruments: they respond differently to various types and energies of radiation. For instance, some are more sensitive to X-rays than to gamma rays from Cobalt-60. When the readings are interpreted, the type of source to which the person has been exposed must be known so the readings can be corrected for this difference in sensitivity.

You can see why plant radiation surveys are important. You have to know what kind of radioactivity exists, where it is coming from, and what amounts are likely to reach personnel before your plant is safe.

If you are using unsealed radioisotopes, and there is a possibility of their becoming airborne, you have one of the most serious types of exposure. To know how much radioactive material might be inhaled, you must monitor the air. All uses of unsealed radioisotopes should be evaluated by a health physicist or industrial hygienist who is experienced in judging radiation hazards. This will help you obtain the full picture of each man's possible dosage and will show you what control measures are needed. You may also need to monitor solid and liquid process wastes and even effluent air, when these are involved in your radiation application.

One of the best ways to be certain your plant is safe is to have a consultant check it periodically—perhaps every year or two. A qualified radiation consultant may be able to bring

you up to date on procedures, perhaps even to eliminate unnecessary precautions. Besides, these checks offer reassurance to both management and employes.

What is done with all this information on personnel exposure? A file is set up for each radiation worker. Data from the dosimeters and film badges are evaluated weekly or bi-weekly and rigorously recorded. Reports from medical examinations also will go into the file. In short, all the information about exposure of each worker is kept in one place. Every entry is kept for at least 10 years after it was made, even if the man leaves the company before then. The company keeps these records to protect both the employe and itself. A worker's claim of damage from radiation can thus be carefully investigated.

This record should also include every worker's exposure *outside* the company. This information will be obtained by the plant physician during a regular check-up. X-ray diagnosis or radiation therapy away from the plant might cause much heavier dosage than anything received on the job. The overall record of exposure again serves to protect the man and the company. This record-keeping may seem onerous. It needn't be, if the proper system and procedure is established first. This is another place where a health physics consultant can help.

9 What special medical arrangements are needed?

Personnel monitoring, area radiation surveys, and air monitoring of radioactivity are necessary, but they cannot spot actual physical damage in a person. For this reason, if your firm is a large-scale user of radiation, a competent physician should be retained to carry out the medical part of the radiation program. In some states the company is required to have a medical program.

For effectiveness, the physician should give a pre-placement or pre-employment medical examination to all prospective radiation workers. In it, he should note all of their previous radiation exposures, including those received for diagnostic and therapeutic reasons. He will make a complete physical examination, including skin, eyes, and hearing. A complete blood count should be taken to establish a base line for the individual prior to radiation work.

Part of the purpose of the pre-placement examinations is to spot individuals who are physically or emotionally unsuited to radiation work. The patient-doctor relationship is valuable in detecting unusual fear or apprehension about radiation work during the person's employment. The doctor will build up a case history of a man that will be kept up to date by routine annual medical examination. These, and special examinations resulting from an accident or over-exposure as indicated by the film badge, constitute valuable information for management as well as the worker. The doctor should receive the complete cooperation of supervisors, as well as the radiation safety officer, in determining the workers' continued suitability for radiation work. These examinations will help to reassure the worker about his physical condition and the risks. It will also let him know that someone is personally interested in his welfare.

When a worker's job with radiation is ended, the physician will give him a thorough physical examination and report his findings to management. This report along with the summary of all monitoring information will close out the worker's file. However, this file should be saved as a valuable permanent record. Thus, the medical program serves, as a final bulwark of protection for the employer as well as a benefit for the worker.

The author summarizes

In summary, the most important part of a company's work in the Atomic Energy field will be that part played by management in assuming the responsibility for the control of all radiation hazards to the public and employes. This is not a responsibility that can be dictated by law. It is a moral obligation to be assumed by the administration so that they may continue to reap the benefits of this valuable industrial tool. If they once fail to protect all interests involved in this work, it cannot help but have an effect on new-comers to the field. It's effect upon the company's reputation may be devastating. More than this, it could cause both the public and labor to consider this type of work a hazardous occupation and a risk to the community. This it is not. To those firms whose managements assume these responsibilities, who provide the necessary safeguards and education, will rightfully go the blessings of peacetime atomic energy.

Mr. Gallaghar

Robert G. Gallaghar is health physicist for Liberty Mutual Insurance Co. and is located at the firm's Research Center at Hopkinton, Mass. He assists policyholders with radiological problems and helps the company evaluate new uses of radiation. Mr. Gallaghar also teaches health physics at Harvard University and is a guest lecturer on radiological safety at New York University's Institute of Industrial Medicine.

Before he joined Liberty Mutual he served as health physicist for the U.S. Public Health Service. He has been a consultant to hospitals, industrial firms, and several research educational organizations. A considerable part of his time is spent investigating radioisotope accidents, and in research on decontamination methods. He belongs to the Inspection Committee of the Mutual Atomic Energy Insurance Pool.

Mr. Gallaghar was in the first group of fellowship students trained in health physics by the AEC at the Oak Ridge National Laboratory. He had post-graduate training at Hahnemann Medical College and the University of Cincinnati. His undergraduate work was completed at Stanford University.

He founded the Cincinnati Radiation Society, is treasurer of the Health Physics Society, and was responsible for the creation of the Atomic Energy Library at Cincinnati University.

INTERDEPARTMENTAL UNDERSTANDING breeds good relations, which in turn make maintenance easier. Four departments here, are getting ready for a turnaround: maintenance, process, safety and inspection.

Cooperative Relations

. . . How they make for good maintenance

By ROY W. BEST

Mechanical Supt.
Cities Service Refining Corp.,
Lake Charles, La.

THE Process and Maintenance Departments in our plant at Lake Charles have a clearly defined relationship. Process is the line organization having and exercising final authority over what maintenance work is to be done, and at what times the process equipment is available. Maintenance is a staff service organization that determines how the work is to be done, and is the group that actually does the work.

This relationship functions up and down the line—from rank and file workers to department heads. The relative strength or weakness of personalities in the two departments plays no part in this Cities Service operation.

Final authority to do or not to do rests with the Process Department. The personnel of the departments clearly understand their functional relationship and the total cooperative effort is very productive.

Definition of responsibilities extends also to the Inspection Department, another staff group independent of both the Maintenance and Process Departments. This group inspects equipment, logs experience data indicating rate of deterioration and recommends repairs.

The Process Department (being directly responsible for refinery throughput and quality of product) must have authority to decide the outage of equipment when there is a choice of replacement and major repairs or "patch repairs." They establish unit turnaround dates and generally decide the scope of work for various turnarounds. This authority vested with Process eliminates "buck passing" from one department to another.

Equally important is the obligation imposed on the Maintenance Department and other staff groups to be more fully aware of their responsibility in furnishing the best possible advice, assistance and cooperation to aid in decision-making. Efficient liaison between Process and Maintenance is essential for the desired relationship. Maintenance must make available to Process all current maintenance records, man-hour and material estimates for planned and emergency work, and must furnish practical information and advice from the welding, machinist, electrical, instrument and other highly specialized maintenance sections.

Here's how the different departments work together on an actual job:

Some 60 days before the scheduled shutdown date, the Process and Maintenance Departments jointly compile a preliminary turnaround work list. Process, in establishing the final scope of work to be submitted for top management approval, will—in addition to established budgeted items and routine inspection repairs—consider the following factors:

1—Additions, alterations and tie-in connections that must be done during the shutdown period in conjunction with future unit expansion projects.

2—Failures of equipment during the past run that may be corrected by changes in composition of materials, improvements in design of mechanical devices, extension of erosion and corrosion lining installations, and improved methods of cleaning. Engineering, Inspection and Maintenance Departments generally present joint recommendations on these items.

3—Typical items suggested by Maintenance to facilitate its own efforts in future turnarounds are:

a—Additional manways in towers and major catalyst transfer lines to expedite cleaning and repairs.

b—Permanent steel platforms to eliminate recurring construction of temporary scaffolds.

c—Permanent power wiring in-

stallations for welding machine connections.

Consideration of the above factors involves consultation with members of Engineering, and Laboratory, outside contractors, material manufacturers, and frequently, representatives of other refineries with similar problems. Line and staff cooperate closely on the work list compilation so that the final scope of work, approved by Process and recommended for top management approval, may be completed in the allotted downtime and with satisfactory economic justification for all items.

Maintenance must be realistic in requesting items intended solely to aid in the execution of the turnaround function. Process should be equally alert to the future maintenance problem when major alterations in design are being considered, such as fixed material handling facilities, adequate openings for inspection and repairs and standardized sizing of equipment for minimum warehouse stock inventory.

The scope of the turnaround work, once finalized and approved, is furnished all sections of the Maintenance Department at least 30 days before the scheduled shutdown date. During the 30 day period preceding the start of the cat cracker turnaround, Process and Maintenance must cooperate fully and coordinate their work closely because the limited, fixed maintenance manpower must be judiciously balanced to reach a threefold goal.

1—**Provide preparation of maintenance facilities**—The portable freight elevator is erected, public address equipment is installed for complete unit coverage, portable field office and meeting room is located and equipped adjacent to the Unit, tool room and small parts trailer are stocked and moved to the site, specialized rigging equipment is hung, scaffolds erected, slip blinds placed at the proper location, necessary insulation removed for vessel and piping inspection, welding machines placed throughout the unit to serve the work load, and all materials brought to the unit and placed as near the work projects as is practical.

2—**Perform maximum pre-turnaround work** on cat cracker unit equipment that may be removed during the unit operation. A study of each turnaround generally reveals one or two classifications of work—boilermaker, welder, pipefitter or machinist—that control the length of the shutdown period. Therefore, to minimize downtime and overtime, we have to study carefully equipment performance, past repair records and service factors on that equipment that may be removed from service during Unit operation with only minor effects on the throughput. Spare equipment being at the economic minimum, removal of operating equipment not only complicates the operator's job but results in a reduced throughput and more delicate operation.

3—**Upgrade the maintenance level** in other process units—Inasmuch as the few critical craft classifications are required in full force at the cat unit it is important to minimize the need for these craftsmen in other process areas during the cat unit turnaround. Equipment service records and performance data on questionable items are reviewed and if manpower is available the equipment is inspected and repaired.

Planning and scheduling maintenance manpower during this 30 day period is indeed critical and requires an impartial effort not only by Process and Maintenance, but also by the various process sections, because the actual work done is sifted from requests asking twice the available manpower.

A week before the scheduled shutdown date, a general turnaround meeting is held with the Maintenance Section heads and engineers, Area Process Superintendent and staff, and the Inspection Department. A Safety Department representative also attends. Process advises the date and hour scheduled for the shutdown and outlines maintenance manpower required by shifts to help the operators bring the Unit off stream. This time and manpower will vary according to the condition of the unit and normal problems connected with the shutdown procedure.

Minor additions, and alterations in

About Cities Service at Lake Charles

Cities Service Refining Corp. began operating the Lake Charles, La., refinery in late 1943. The present operation includes three principal crude units (180,000 b/d capacity) supplemented by an additional combination unit, a propane deasphalting unit, vacuum unit, three fluid catalytic cracking units and a catalytic fractionation unit, two alkylation units with Girbotol treating unit, a central treating plant, a Fluid Hydroformer unit with a Hydroformer feed preparation unit, sulfuric acid plant, central steam and power generation units, and storage and transport facilities.

The Maintenance Department is staffed with 900 employes (about one-half of the plant personnel). This is essentially a fixed figure, with a maximum temporary supplement of seventy-five "casual workers" for catalytic cracking unit turnarounds. The Maintenance Department includes Maintenance Planning and Scheduling, Mobile Equipment, and Warehouse Departments, and is directly responsible to the Chief Refinery Engineer.

With the general exception of complete process unit and storage tank painting, storage tank cleaning and major insulation projects (normally contracted for economic reasons) all maintenance is done by the Maintenance Department. Less than 5% of the work force, which is sized primarily for the average maintenance work load, is used for new construction work. New work is limited to smaller construction jobs carried on in conjunction with unit turnarounds.

Our catalytic cracking units are scheduled for turnaround on a 24-36 month basis. So far we have, with few exceptions, maintained this schedule. This means one or two cat unit turnarounds each year. The central cat fractionation unit receives an entire or partial turnaround each year.

Meet the author

Mr. Best

Mr. Roy W. Best, mechanical superintendent for the Lake Charles, La., refinery of Cities Service Refining Corp., was born in 1911 at Enid, Okla. In 1933 he received a B.S. degree in mechanical engineering from Kansas State College, then joined Cities Service Oil Co. He held positions as laborer, mechanic's helper, operator, engineer and superintendent at Ponca City, Bartlesville, Chicago, and Cleveland. The last-named job was with the marketing dept. in charge of maintenance and construction of service stations and bulk plants. He joined Cities Service Refining Corp. in 1942, at the New York office. He helped design the Lake Charles refinery, and transferred there as zone engineer in 1943, receiving his present position in 1947.

the approved scope of work are presented by Process and discussed to determine the effect on the scheduled downtime and to allow Maintenance to correlate such items with the over-all plan.

The Process department supplies information on unusual operating problems and difficulties for further guidance, and may request manhour estimates and anticipated work schedules for major pieces of equipment.

The Safety Department reviews hazards that may be met in the contemplated work, and offers suggestions for corrective measures to minimize accidents.

The Inspection Department discusses conditions discovered during past turnarounds and forecasts what conditions may be anticipated.

Maintenance will lay out its general plan of attack and explain the planned apportionment of maintenance manpower and supervision on the various shifts. New cleaning procedures, special tools, equipment and techniques will be explained and discussed. Finally, the group will be reminded that the responsibility for the success of the operation is a joint one requiring the ultimate in cooperation, coordination and mutual understanding.

The turnaround

The date of the shutdown arrives and the maintenance forces previously scheduled for the shutdown are provided. If the operation follows the plan, all phases are anticipated and the unit "comes to rest" with adequate maintenance forces ready for hot bolting and opening the vessels.

When a catalytic cracking unit has been in continuous operation for 24 to 36 months, obviously its shutdown is considerably less predictable than after a shorter run, and the catalyst removal operation may vary widely. As Process becomes aware of difficulties that may necessitate a change in manpower needs and procedures they discussed with Maintenance in time for plans to be altered accordingly.

Experience records from past turnarounds and engineering plans and specifications covering new construction work provide the general basis for determining work procedures and materials required. However, the best made plans are subject to day-by-day revision as vessels are opened and materials and equipment are available for inspection. The over-all plan is flexible and is adjusted each day in daily meetings of all key Maintenance personnel together with top level Process, Inspection and Safety supervision.

These progress meetings are held each morning and afternoon during the catalytic cracking unit shutdown period to allow the Maintenance Department turnaround supervisor to be familiarized with job progress, make alterations in manpower assignments where necessary and to allow the Maintenance section heads to discuss and formulate detailed work procedures on jobs of a specialized nature —repairs or alterations peculiar to the particular turnaround where the scope of work could not be anticipated and planned before shutdown.

Top level Process Department supervisors attend each meeting to keep abreast of progress and for consultation on Inspection Department recommendations and safety procedures. The responsibility for repair work methods rests with Maintenance, but, because Process is directly concerned where the expenditure is large or the length of downtime is extended beyond the initial estimate, Process representatives are always welcome to attend meetings where procedure plans are being formulated.

The turnaround continues until the final stages when vessels are ready for closing and equipment is prepared for testing. From this point to the actual start of a new run, time is a critical item. Process and Maintenance must continue their teamwork, coordinating the "making ready" of the equipment in proper sequence with the minimum delays and expenditure of manpower.

A catalytic cracking unit turnaround has been used to illustrate the practical application of the line-staff relationship between the Process and Maintenance Departments. The same relationship is equally effective for smaller unit turnarounds and day-to-day maintenance projects. Obviously, despite some rough spots, it is a far more efficient and practical arrangement than a relationship where relative responsibilities are ill-defined and are subject to the vagaries of personalities.

The MC Problem Corner
Petroleum Processing's Maintenance and Construction Panel answers your questions in this regular monthly feature.

Chemical-cleaning insoluble deposits from turbine blades

What methods are there for cleaning deposits from steam turbine blades with a minimum of downtime? Can these blades be cleaned in place without dismantling the turbine?

Refining, Gulf Coast.

REMOVAL of insoluble deposits from steam turbine blades can be a tough job, often requiring that the turbine be offstream long enough to remove the wheel covers and diaphragms, clean, and then reassemble. Actual cleaning depends on the deposits.

One chemical cleaning method, if the turbine can be operated, is to fill the casing with a 5-10% solution of Oakite No. 88 to a point where the buckets in the bottom half of the casing are completely submerged. The turbine is operated at 10-15% of rated speed for 8-12 hours with the exhaust vented to atmosphere.

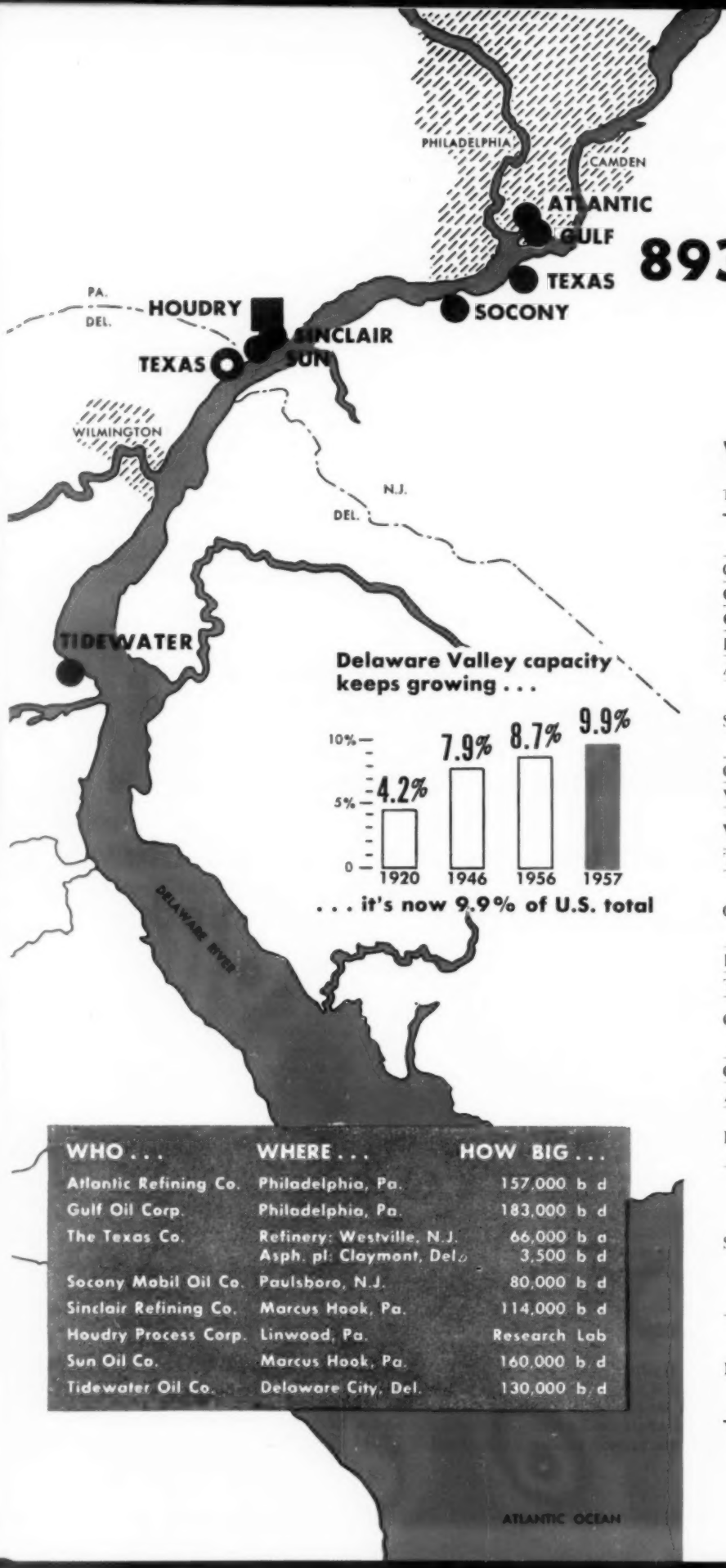
If the turbine cannot be operated, the wheel should be revolved manually three-fourths of a turn every hour for about 4 hours, after which the cleaning solution is drained and the turbine returned to operation.

A variation on chemical cleaning suggests using a 55 gal drum with a perforated steam coil in the bottom. The drum is filled with a 10-12% water solution of Oakite No. 32. The temperature of the solution is brought to 185°F with the steam coil, and the solution injected into the operating turbine. A very clean turbine should result after injecting about three drums of this solution.

The main disadvantage of in-place cleaning methods is that the deposits in the corners at the intersections of the shroud rings and blades may not be completely removed.

(Next month: Mechanical cleaning)

Send YOUR questions on maintenance and construction to PETROLEUM PROCESSING's M&C Editor.



WHO . . .	WHERE . . .	HOW BIG . . .
Atlantic Refining Co.	Philadelphia, Pa.	157,000 b d
Gulf Oil Corp.	Philadelphia, Pa.	183,000 b d
The Texas Co.	Refinery: Westville, N.J.	66,000 b d
	Asph. pl: Claymont, Del.	3,500 b d
Socony Mobil Oil Co.	Paulsboro, N.J.	80,000 b d
Sinclair Refining Co.	Marcus Hook, Pa.	114,000 b d
Houdry Process Corp.	Linwood, Pa.	Research Lab
Sun Oil Co.	Marcus Hook, Pa.	160,000 b d
Tidewater Oil Co.	Delaware City, Del.	130,000 b d

893,500 b/d th Y

By STUART D. BOYNTON
Assistant Editor

Valley refining fact r

Total capacity: 893,500 b/d; employes: 15,917 Str

Refining Companies	
Capacity (b/d)	
Original capacity	
Onstream date	
Employes	
Acreage	
Storage capacity	
Crude topping	
Vacuum distillation	
Visbreaking	
Thermal cracking	
Catalytic cracking	
Fluid coking	
Thermal reforming	
Catalytic reforming	
Cat. polymerization	
Alkylation	
Hydrogen processing	
Solvent refining	
Misc. units	

Year, and Still Growing

What's ahead for "Valley" refining?

roundup—the complete, 7-refinery story

SOMETIME this year Delaware Valley refineries will hit 893,500 b/d total capacity. Already the second largest petroleum processing center in the U. S. (the Gulf is first) the Valley is well situated to cash in on the thriving and expanding eastern seaboard market. So oilmen are looking ahead to still further growth. How fast and how far they will go is likely to depend on these factors:

1—Continued access to cheap crude without import restrictions more severe than those in effect before the Suez stoppage.

Stream-day figures used unless otherwise stated

Socony Mobil Oil Co.	Atlantic Refining Co.	The Texas Co.	Gulf Oil Corp.	Sun Oil Co.	Tidewater Oil Co.	Sinclair Refining Co.
80,000	157,000	66,000	183,000	160,000	130,000	114,000
5,000	unknown	40,000	16,000	1,200	130,000	10,000
1917	1870	1949	1927	1902	1956-57	1925
2,700	3,902	715	2,300	4,350	500	1,450
1,000	633	715	978	1,982	450	267
(crude) 2,125,000 (products) 3,000,000	(crude) 3,406,000 (products) 5,392,000	(total) 7,435,000	(crude) 3,400,000 (products) 8,600,000	(total) 8,000,000	(total) 7,000,000	[2]
80,000	157,000	66,000	183,000[1]	160,000[1]	130,000	114,000
43,000	43,000[1]	[2]	68,000	[2]	[2]	[2]
[2]	23,000[1]	[2, 3]	22,000 Gulfiner	[2]	[2]	[2]
				[2]	[2]	32,000
35,000 TCC	44,000[1]	35,000[1] FCCU	82,000[1] FCCU Kellogg	76,000[1] Thermofor Houdriflow Houdry fixed-bed	102,000 FCCU	36,000 Orthoflow
					42,000	
	10,000[1]	9,000[1]	7,200	[2]		
20,000 "Sovaformer"	12,000[1] "Catformer"[3]	12,000[1]	16,000 Platformer[2]	33,000[1] (see Misc.) Houdriformer	45,000 Houdriformer	20,000 Sinclair-Baker
	1,900[1]	7,500[1]	3,500	[2]	15,800	2,500
1,800 HF	5,400[1]	2,000[1]	3,100	7,000[1]	5,000	undisclosed
22,000 hydrodesulf. under constr.	8 mill cu ft/d desulf. (charge)	6,500 Hydrotreating	two 25,000 hydrodesulf. in constr.	[2]	30 mill cu ft/d (manufacturing) cat. desulf.[2]	10,000 hydrodesulf.
4,800 Duo-Sol 7,200 furfural 6,500 MEK 7,300 propane dewax.	5,000[1] lube oil 4,000[1] prop. deasphalt.	14,000[1] furfural	1,200 lube oil	11,800[1] lube oil	27,000 Udex	
	9,000[1] asphalt 100 t/d ammonia		130 t/d sulfur	300 t/d[1] ammonia 14,000 of cat. reformer cap. for aromatics recovery	sulfur 90 mill cu ft/d vapor recovery	

[1]Barrels per calendar day [2]Existing capacity undisclosed [3]Additional unit planned

2—Prospects for getting more crude into the area.

On both points there is room for optimism. While import restrictions (so far voluntary) seem to be a permanent part of government oil policy, the proper proportion of imports to domestic production looks to be in for further rounds of negotiation between the interests concerned.

Valley refiners are deeply involved in the imports controversy. None of them uses a majority of Mid-East crude—even in "normal" times. But what they do use offers an attractive cost advantage in this day of narrow margins. Coupled with the economies of big-tanker transportation, this advantage is something they are willing to bet on to the extent of heavy investment in processing facilities designed to handle the sulfurous Middle East product.

At this early stage, no one can guess what the outcome of the imports tussle will be. But where the stakes are as high, and the contending interests as economically powerful, issues are not usually settled except over a long period. A severe imports quota, or an oil tariff, could retard growth of refining in the Valley. But the region's increasing prosperity should offer a market big enough to keep refiners on the move.

The other critical factor is whether refiners will be able to bring in larger volumes of crude at no significant added unit cost. Two developments are likely to play a part:

- Industry pressure behind deepening of the river channel.
- The off-shore terminal and pipeline project planned by three companies.

The channel from Delaware Bay to Philadelphia has an authorized depth of 40 ft. Maintenance work was reduced during World War II and stepped up only recently. Some oilmen say that even today the channel is well under 40 ft in places. In practice, the cut-off point for fully loaded tankers is around 30,000 dwt. Heavier ships lighter part of their load into smaller tankers at the mouth of the channel. Now that two dozen tankers of 40,000 dwt and over are in operation—and 175 in construction or on order—this practice threatens to become seriously uneconomical.

For these larger ships, even an actual 40-ft channel would be insufficient. So there is pressure from oil and maritime interests for Congressional authorization and funds for a 50-ft channel. A resolution for engineering studies did get through, but obtaining money and authorization for the full project might take many years.

Meanwhile, the off-shore pipeline terminal and trunk line are definitely set. Pipeline subsidiaries of three oil companies—Sun, Atlantic, and Cities Service—have set up the Cape Pipe Line Co. to carry out the project. An unloading platform will be built a few miles off the shore in the bay. A line will be installed capable of handling 500,000 to 600,000 b/d of crude. The biggest tankers will be able to discharge into it. There will be storage on the shore and a trunk line running up the west side of the river to the Philadelphia area. Laterals will connect with refineries.

Cities Service no longer has a refinery in the Valley but the other two expect substantial economies from the arrangement. The project will cost $40,000,000 to $50,000,000 but is thought to be a "cheaper" solution (and quicker—completion is scheduled for 1960) than working for a 50-ft channel.

How the Valley grows

Over the years, Delaware Valley refiners have been cutting themselves a larger slice of national refining capacity. On the basis of U. S. Bureau of Mines figures, capacity grew 73% from 1947 to 1956, compared to national growth of 62%.

The refining capacity in the Valley moved from 4.2% to 8.4% of U. S. capacity from 1920 to the beginning of 1956. And during the latter year an additional 42,000 b/d was added, not counting the 130,000 b/d Tidewater plant, which is gradually being put on stream. By May of this year, then, the new capacity should total 172,000 b/d, bringing the Valley's grand total to 893,500 b/d, or 9.9% of this year's expected national refining capacity.

The Valley refining family may be in line for a fillip in the form of another new member. Persistent reports say that a major company now without an East Coast refinery is studying the Valley and looking for a site along the eastern shore of the Delaware River.

Why is the Valley big?

1—The market

Refiners don't have to look far for their market—they're right in the middle of one of the biggest.

The 11-county area surrounding Philadelphia (4565 sq mi) holds some 4.7-million people. Their total income in 1955 was almost $9 billion. Individual average purchasing power in the Valley was 14% more than the national average; the former figure was $5,477 for that year against $4,785 nationally.

Another way to put the Valley's comparative prosperity: 52.6% of the region's inhabitants had net incomes of $4000 and over, compared to 45.2% nationally.

They buy a lot, too. Retail sales for Philadelphia's Standard Metropolitan Area (eight counties, totalling 3580 sq mi) stand in fifth place among the 10 leading trading areas in the country. Per capita sales were over $1100 in 1955. Another fact about this prosperous Delaware Valley: it has an unusually high proportion of homeowners, being in this respect at the top of the list of U. S. metropolitan areas of over one million population, according to the 1950 census.

But the Valley oil industry actually serves a much larger market than this 11-county region. Take a 100-mile radius, which is closer to the size of the area dominated by products from Valley refineries. Here live almost 23 million people, representing 14% of the U. S. population; their net income totals around $44 billion a year —16% of the U. S. figure; retail sales during 1955 were estimated to be $27 billion, or 15% of national retail sales. Thus the area commands a slightly larger slice of income and retail business than its share, based on population.

Several Valley refiners send products well beyond this 100-mile radius. Altogether there are five product lines running into Pennsylvania, New Jersey, the New York harbor area, New York state, Ohio, and Maryland.

2—The river

Since man first invented the boat, rivers have given some areas an edge over others in commercial development. Even before the days of low-cost foreign crude and big-tanker transportation, location on the Delaware River was advantageous. For one thing, it is deep enough and wide enough to afford most vessels easy navigation at least as far as Philadelphia—101 statute miles from the ocean. It says a lot for this advantage that today there isn't a single crude pipeline serving the area.

The Delaware first figured in oil commerce back when refineries were in business to process whale blubber.

Mr. Shaw
Atlantic

Mr. Timms
Gulf

Mr. Self
Sinclair

Mr. Cranston
Socony

Mr. Naylor
Sun

Mr. Chandler
Texaco

Mr. Caine
Tidewater

Who's who in Valley refining

Atlantic Refining Co.—Integrated company with two refineries (other one is at Atreco, Texas). Among subsidiaries is Atlantic Pipe Line Co. (100%), which operates Atlantic Refining's pipe line system, consisting of 1700 miles of trunk lines, 600 of gathering lines.

Refinery address: 3144 Passyunk Ave., Philadelphia; downtown office (company headquarters): 260 S. Broad St. Phone number downtown: PE 5-2345.

Refinery manager: D. T. Shaw; assistant manager: J. S. Patchin; superintendent, refinery department: H. V. Hume.

Gulf Oil Corp.—Integrated company owning six U. S. refineries, and with interests in two foreign refineries. Among its subsidiaries and affiliates are Gulf Refining Co. (100%), which produces and transports crude and operates the Toledo and Cincinnati refineries; Goodrich-Gulf Chemicals (50%), which makes synthetic rubber.

Company address: 1515 Locust St. (executive offices); phone: PE 5-4240.

Refinery manager: J. O. Timms; assistant general superintendents: H. W. Magee and R. J. Metcalf.

Sinclair Refining Co.—Refining and marketing company wholly owned by fully integrated Sinclair Oil Corp. Refining company owns seven refineries and two distributing subsidiaries: Richfield Oil Corp. of New York, operating in New England and Eastern Seaboard states; and Hughes Oil Co. of Chicago, distributing in Chicago area.

Refinery address: Marcus Hook, Pa.; phone: CH 5-1191. Has no administrative office in Philadelphia.

Refinery manager: Rex J. Self; assistant manager: Ira T. Fritz; operating superintendent: David Stewart.

Socony-Mobil Oil Co.—Integrated company with 12 U. S. refineries, six foreign. Among subsidiaries and affiliates are General Petroleum Corp. (100%) on the West Coast, Magnolia Petroleum Co. (100%) in southwest, Standard-Vacuum Oil Co. (50%) in the Eastern Hemisphere, Arabian American Oil Co. (10%).

Refinery address: Paulsboro, N. J.; phone: HA 3-1040. No administrative office in Philadelphia.

Refinery manager: Erlis Cranston; assistant manager: Stuart W. Thomson; operating superintendent: H. D. Chapman.

Sun Oil Co.—Integrated company with three refineries. Besides Marcus Hook, there is one at Sarnia, Ont., and Toledo, Ohio. Owns marketing companies in Europe for lube oil and greases. Sun Oil Co., Ltd. (100% owned) operates Sarnia refinery and markets in Canada. Wholly owned Sun Shipbuilding & Dry Dock Co. operates near Marcus Hook, can make oil refinery equipment.

Refinery address: Marcus Hook, Pa.; downtown office (Sun headquarters): 1608 Walnut St. Downtown phone: KI 6-1600

Refinery manager: C. Calvin Naylor; superintendent-refining: Walter C. Huffman; refinery engineer: Frank W. Bowen.

The Texas Co.—Integrated company owning 11 U. S. refineries with total capacity of over 600,000 b/d. Subsidiaries include McColl-Frontenac Oil Co. in Canada (59%) and Texas Petroleum Co. in Latin and Central America. Affiliates include Arabian American Oil Co. (30%), California Texas Corp. (50%), Bahrain Petroleum Co. (50%), Trans-Arabian Pipe Line Co.("TAPline")(30%)and others.

Refinery address: Westville, N. J.; telephone: GLoucester 6-1380. Has no office in Philadelphia.

Refinery superintendent: H. H. Chandler; assistant superintendents: W. R. Sorenson and W. E. Toms; chief engineer: J. R. Riess; chief chemist: W. H. Roach.

Tidewater Oil Co.—Integrated company with two major refineries—at Delaware City and Associated, Calif. A subsidiary operates a small refinery in California. Nine subsidiaries and affiliates are engaged in pipeline operation, exploration activities, production of crude and natural gas, and in overseas ventures.

Refinery address: Delaware City, Del.; phone: TA 4-4518.

Refinery manager: George C. Caine (manager of company's eastern division manufacturing department); assistant managers: Benjamin G. Jones and James McDonald; chief engineer: John J. Mack.

For more details, turn page →

After petroleum was discovered, and refineries sprang up in Pennsylvania, Philadelphia served as a nearby market and the river as a convenient means of exporting products.

With the opening of the Texas fields in 1901, coastal shipping became practical for transporting crude and products to the burgeoning eastern markets. As the automobile developed into a serious fuel and lubricant market, the volume of shipping mounted. World War I gave a tremendous push to transatlantic and coastal shipping in and out of Philadelphia.

World War II had the same effect, and after it tankers graduated in size to the "super" class—20,000-30,000 dwt. More than ever was it a cost advantage to be located at tidewater. With the modern trend to locate refineries at consuming rather than producing areas, Delaware Valley refiners find themselves ahead of the game.

HOUDRIFLOW cat cracker at Sun Oil Co., Marcus Hook

R&D LAB of Houdry Process Corp. at Linwood, Pa.

More about oil in the Valley

Inside the Valley companies

Sun came in with crude from Texas

When Spindletop gushed in 1901, Joseph N. Pew went down to the fishing town of Marcus Hook and bought 82 acres of what was formerly an amusement park. The refinery Sun Oil Co. built there went on stream a year later with 1,200 b/d capacity, mostly to make lubricating oils. Unlike the other refineries in the area, which were making lube oils from Pennsylvania paraffinic crudes, Marcus Hook began operations with naphthenic crudes from the new Texas fields. It wasn't until the 20's that Sun went into gasoline manufacturing and marketing.

In the mid-Thirties, when the Houdry catalytic cracking process came in, Sun built one of the first units at Marcus Hook, where it still stands and operates. Sun was an early investor in Houdry Process Corp. and put $11 million into research on catalytic cracking. Today it owns 48% of the company, and Houdry units are all over the Marcus Hook landscape: two reformers, of 14,000 and 18,000 b/d capacity, a 30,000 b/d Houdriflow cracker (designed to use the Houdresid process), and the pioneer Houdry fixed-bed cracker.

Expansion has been a regular thing at Marcus Hook. In 1946 it could handle 135,000 b/d, 10 years later this had been boosted to 145,000 b/d, and over the past year another 15,000 b/d has been added. Avgas and high octane motor fuels are turned out in quantity because of the plant's unusually high ratio of alkylation (7000 b/d) to total capacity. But the plant makes a wide variety of products, including petrochemicals.

The 14,000 b/d reformer is used to recover aromatics—hydrogen goes to the ammonia plant. Besides the B-T-X petrochemicals, the refinery makes sulfonates, sulfur, naphthenic acids, and propylene tetramer and trimer. Sun has the largest plant in the country for making anhydrous ammonia from refinery streams. The 300 t/d unit was shut down last year after an explosion but is once again onstream.

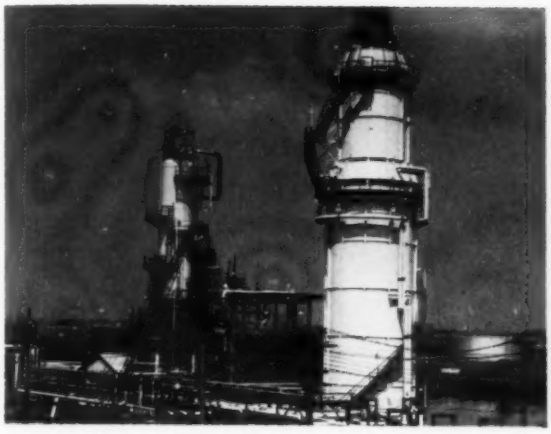
Houdry Process still pioneers in oil research and catalysis

When the first catalytic cracking unit went onstream in 1936 a new era in petroleum processing was opened. The process, of course, was Eugene J. Houdry's, and it was brought to the commercial stage by a small group of specialists working in the company he founded five years before—Houdry Process Corp.

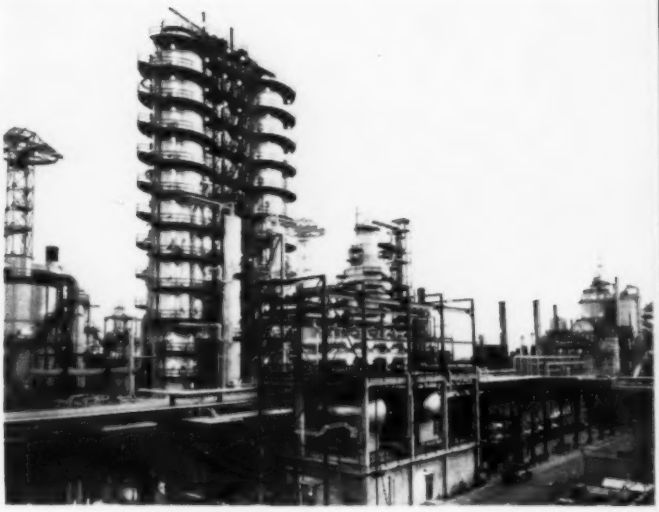
Process research and development still serves to identify the company for most refiners, but its operations have expanded in logical directions over the years. Process design and engineering of licensed units is handled in the company's Philadelphia headquarters; engineering and construction in petroleum and other industries is available through a subsidiary, Catalytic Construction Co., also in Philadelphia. A wide range of catalysts is manufactured in a Houdry plant at Paulsboro.

Process research and development is centered at laboratories in Linwood, Pa., about 18 miles south of Philadelphia. Of 230 employes, 75 are highly trained scientists and engineers, including some world-renowned authorities on catalysis. Fundamental research into the mechanisms and kinetics of catalysis is one of the continuing interests of the laboratories. One phase of a broad study of homogeneous catalyst systems now receiving special attention is the activation of molecular hydrogen, which has great significance for the "hydrogen-rich" refinery. Success here could lead to a catalyst able to make hydrogen reactive at greatly reduced temperatures and pressures, thus radically affecting the economics of hydrogen processing.

In process research the company is working to extend the Houdry reforming process to the C_5-C_7 range of hydrocarbons; improve the dehy-



NEW VISBREAKER (foreground) at Gulf Oil's plant



CRUDE STILLS (left) are new facilities at Sinclair

-- some of today's highlights

drogenation process, to reduce the cost of making olefins from alkylate; cheapen the butadiene process; and, of course, develop better cracking and reforming catalysts.

Now biggest in the Valley, Gulf launches huge building program

In 10 years Gulf's Philadelphia refinery has boosted its capacity from 68,000 to 183,000 b/d and taken the lead position in the valley.

Now the plant is embarked on a large-scale quality improvement program. Here's the size of it: on the drawing boards or in construction are a 2,800 b/d UOP Platformer, a 2,800 b/d sulfuric acid alkylation unit, and two Gulfiner desulfurization units of 25,000 b/d each. Since this $35 million renovation was announced a year ago, goals have been raised to include another 26,000 b/d Platformer. The first installment, a 22,000 b/d visbreaker of Gulf design, is already on stream.

The plant sits alongside Atlantic's installation at a graceful bend in the Schuylkill River, which branches off the Delaware and cuts through industrial Philadelphia. These two are the only refineries within city limits, though much of Gulf's plant is not at this location. Crude and product tank farms are across the river—crude four and one-half miles away, product just opposite the refinery.

The third property is the crude unloading docks at Hog Island, on the Delaware River. Crude must be pumped three miles to the main storage area, and from there to the refinery. Products are sent back across the river to storage. The Schuylkill docks can handle small tankers and barges.

The Philadelphia management expects a lot from refineries, even that they can be made beautiful, and a plant-wide color brightening job is well underway. As units are shut down for maintenance they are being repainted according to a color scheme devised with the help of outside consultants. Process units are being done in a light gray, with dark gray trim. Color coding is practiced to the extent of having all safety features, such as valves and stairways, painted red.

The tank farms are largely finished, and their bright pastel colors—yellow, pink, blue or green—have transformed the area. "Self-cleaning," titanium-based paints are used and have proved highly successful. The outer surface undergoes chemical change and powders. Rain washes off the powder as it forms, leaving a clean surface. Not only is the "beautification" plan good public relations but on the tanks the lighter tones are also said to cut evaporation losses.

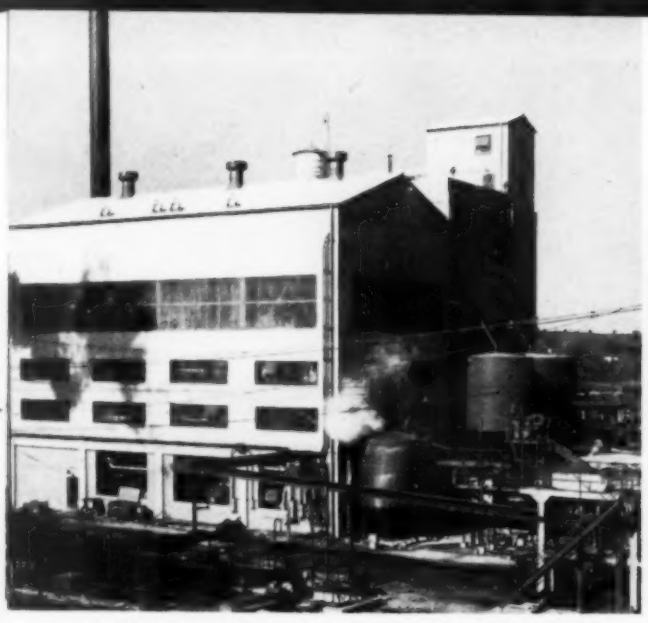
Sinclair modernizes crude units, begins aromatics production

The Marcus Hook refinery recently replaced its old shell stills with two new units having an approximate charging capacity of 60,000 b/d each. The design of the new units increases the proportion of light oils extracted per barrel. Not quite two years ago, the plant started to produce its aromatic petrochemicals and since then has boosted para-xylene capacity. The refinery also produces solvents, a synthetic detergent raw material, and recovers sulfur.

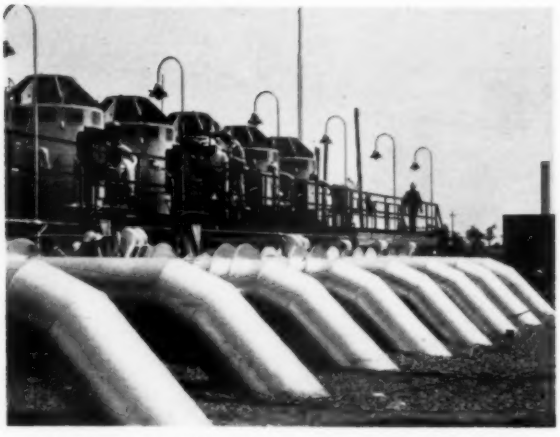
It was at Marcus Hook that the first Sinclair-Baker catalytic reformer went on stream. That was in 1954 and the 16,000 b/d unit became the forerunner of five other reformers planned or onstream using the Sinclair-Baker platinum catalyst.

Crude is delivered by tanker to Sinclair's docks. A recent visitor to the docks has been the 56,000 dwt giant, "Petrolore," which must, of course, lighter part of its load into smaller tankers before making the journey upriver. Product pipe lines carry the refinery's output across Pennsylvania and into Ohio, with a spur dropping south to Baltimore and Washington, D.C. Via the Harbor Line, New York is also connected.

Continued on next page



DETERGENT PLANT at Atlantic's Philadelphia refinery



2000 HP PUMPS drive Tidewater's cooling system

Still more on oil in the Valley

Valley company highlights

First on the scene, Atlantic makes wide range of products

The first shipment of products to leave Atlantic's Philadelphia plant went out in a sailing ship. It was also the first oil actually refined in the area instead of the Pennsylvania oil fields.

That was in 1870, and Atlantic's operations since then have grown right along with the valley. From early trade in kerosine and axle grease the refinery has expanded the variety of its output until it is hard to find a petroleum product it doesn't turn out. Besides the usual refinery fuels and lube oils, there are industrial naphthas, waxes (some 20 kinds), asphalt, ammonia, detergents, sulfonates, plasticizers and others.

Since 1946 the refinery's capacity has increased by 57%—to 157,000 b/d. Some 156 million has been invested in the plant, including $4.5 million for 1957 expansion. Projects underway are a 15,000 b/d Catformer (Atlantic's reforming process), scheduled for July completion, and expansion of the ammonia plant from 100 to 165 t/d, expected this spring.

Atlantic is located next to the Gulf refinery on the Schuylkill River. Crude is delivered by tanker to its terminal on the Delaware River and pumped four miles to storage within the refinery.

Because of the heavily populated area, waste disposal poses a special problem. A chemical-flocculation waste treatment plant was constructed late in 1953 after careful study of the pollution problem and work with a pilot plant. Dry weather and storm water flow up to 19,200,000 gal/day can be handled by the plant. Flows in excess of this are pumped to a storm water basin. After the flow is separated by treatment with lime slurry, aluminum chloride and activated silica, the sludge is passed through rotary vacuum precoat filters. The filter cake is fed to an incinerator-boiler having a rotary hearth. Steam generated in excess of the plant's needs is discharged into the regular yard system. Clarified effluent overflows the flocculation tanks and drains to the Schuylkill River. Major units have been duplicated so that the treatment plant can be kept on stream throughout the year.

Atlantic's main research operation also has headquarters at the refinery. On the staff are 250 men with technical degrees. The company is one of the leaders in research with atomic energy. Its 1 mev "electron gun," a particle accelerator, has been a operation for two years. Two noteworthy experiments were the synthesis of small amounts of hydrazine from ammonia and the production of octane from butanes.

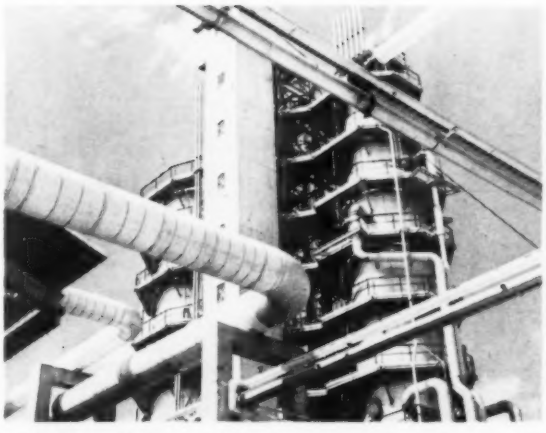
Another feature of the research center is the high-pressure facility, the first set up in the industry for research at pressures as high as 100,000 psi.

Tidewater plant will have largest initial capacity in the industry

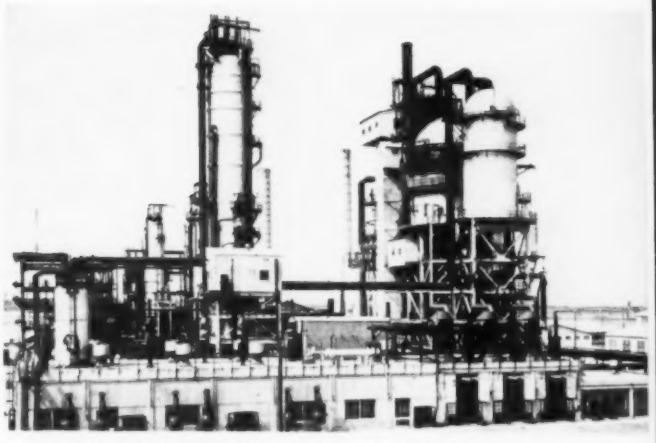
Tidewater will have about $175 million invested in its Delaware City Del., refinery when the full plant goes on stream this spring. With the largest initial capacity of any refinery yet built, it also boasts some of the largest units in operation. Among them are the 130,000 b/d crude unit and the 102,000 b/d Orthoflow fluid catalytic cracker. Both went on stream last fall along with the gas plant and catalytic polymerization unit. The 42,000 b/d fluid coker, with its twin at the Avon, Calif., refinery, will be the largest when it starts operation. Most of the coke will fuel the refinery's power station; the rest will be sold.

The process area covers only 450 of the 5000-acre tract. Even so, clearing and levelling this ground involved moving 2,500,000 cu yd of dirt and supplying the mechanical equipment with a 6000 gal/day diet of diesel fuel. In addition, some 700 acres of swampland along the shore had to be filled for construction of dock facilities. The harbor has a 40-ft turnaround basin, and when dredging is completed the refinery will have a 40-ft channel all the way to the deep water of Delaware Bay. The company's 27,000 dwt tankers will be able to bring a full load (230,000 bbl) directly to the refinery docks.

The river also supplies the refinery's



DISTILLATION UNITS at Socony's Paulsboro plant



FLUID CRACKER (right) at Texaco's Westville refinery

-- the refining story concluded

immense cooling system with water. The heart of the system is nine 2000 hp pumps. Intake at the river is 270,000 gpm, which is driven up a 55-ft grade and 1½ miles inland to the process area. Part of this water is sent through the treatment plant, where 3200 gpm can be treated for the refinery's process needs. Drinking water is drawn from nearby wells and piped through the treatment plant.

Socony cracks and reforms with "home-made" catalyst

The Socony refinery at Paulsboro, N.J., may easily be the only one in the country that makes its own catalyst, a co-precipitated alumina or chromia bead. Two kinds are made: reforming catalyst for the refinery's Thermofor reformer, and a cracking catalyst, half of which is used at the refinery, the rest sold to licensees of Socony's Thermofor cracking process. Production is over 100 t/d.

Paulsboro is one of the older refineries in the valley and has participated in a lot of oil history. Put on stream by Vacuum Oil Co. in 1917, the plant has witnessed at least three industry-wide "firsts." The first continous, two-stage fractionating unit was put in in 1928, the first Duo-Sol lube oil treater went on stream in 1933, and most importantly, the first Houdry catalytic cracker was put in operation three years later. Also developed at the refinery were Socony's Thermofor processes for cracking and reforming.

Perhaps one reason for this progressive history is that the company's main center for research and development of processes and products is right at the refinery. In the long building along one edge of the refinery there are some 400 men with technical degrees. A new analytical lab is now in operation, and for a couple of years the center has been studying the effects of atomic energy with its Van de Graaf accelerator.

Before merger with Standard Oil Co. of New York in 1931, Vacuum Oil specialized in lube oil manufacture and packaging. Probably because of this the Paulsboro lube packaging plant is one of the largest in the east. Soon the plant will convert from batch to continuous blending, using equipment of Proportioneers, Inc. Packaged products are shipped to customers all over the world. The docks can handle three T-2 tankers and a cargo ship at the same time. An interesting feature of the crude unloading operation is the huge hose "reels" sitting along the dock. They are electrically operated and serve to lower the hose onto tanker decks with safety and a minimum of manhandling.

Texaco, a Valley newcomer, has room for expansion

The Westville, N. J., refinery was built in 1949 to meet the booming demand for gasoline and lubricants in the populous Philadelphia-New Jersey area. The clean, spacious plant is located on a choice plot of ground with 2½ miles of river frontage. Its 1600 acres allow plenty of room for expansion, and already capacity has gone up from the initial 40,000 b/d to 66,000 b/d. Avgas capacity was boosted recently with installation of a 2000 b/d alkylation facility.

The Westville plant is the only one Texaco has on the east coast. Until 1949 products had to be shipped up from Port Arthur, and, although some are still imported into the area, the plant is a good example of modern thinking about refinery location—that there is an economic advantage to building near the consuming area, as long as you have cheap transportation to the source of crude.

On the western shore and farther down the river is Texaco's asphalt plant at Claymont, a 3,500 b/d operation.

Don't miss

Philadelphia's new Sheraton Hotel will be the site of the mid-year meeting of the API Division of Refining. See the April PETROLEUM PROCESSING for complete details.

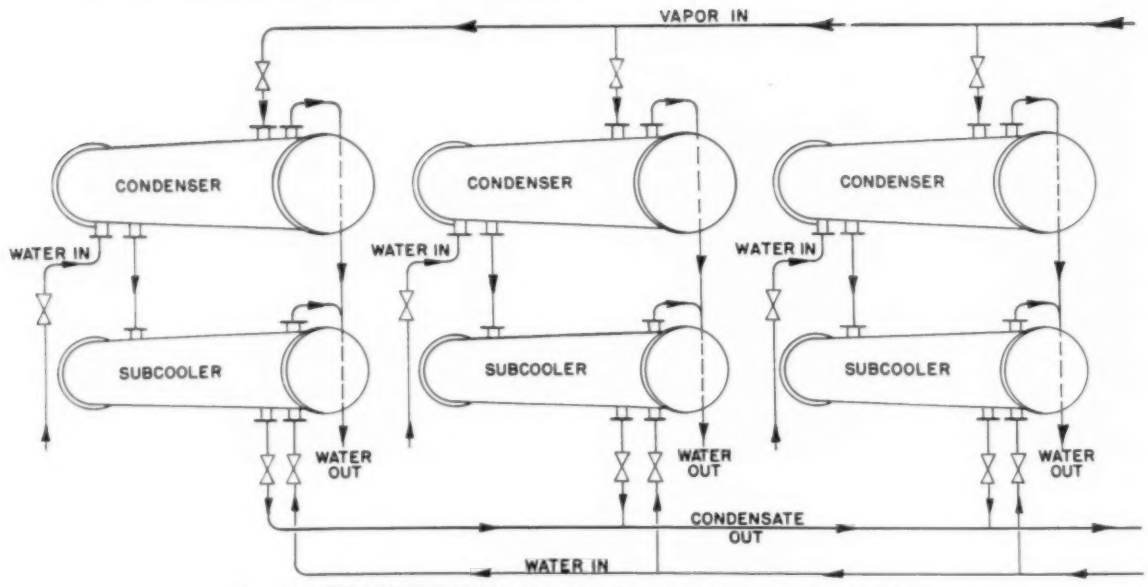


Fig. 4—**ARRANGEMENT** of the butylene condensers and subcoolers

Low-Finned Exchanger Tubing

. . . heat transfer coefficients and other basic information for the design engineer

In this article, the second in a series of three, the discussion centers on the operation of some petrochemical process condensers using low-finned tubing. In addition, design methods are outlined and these methods are checked against the actual performance of the condenser.

Next month, Part III will present design procedures for finned tube convection heat transfer, shell side.

By ROBERT G. NEWELL*

THE development of a low-finned tubing with 16 or 19 integrally-formed spiral fins per inch has permitted the advantages of extended surface to be applied to shell and tube heat exchangers.

The low-finned tubing has bare ends slightly larger in outside diameter than the fins. They are rolled into the tube sheets exactly the same way as the ends of bare tubes are rolled.

This tubing, with its integrally formed extended surface, has gained wide acceptance in heat exchangers in the petroleum, petrochemical and chemical industries.

Because they are a heat transfer agent, so to speak, the fins of extended surface tubing have introduced a problem into the design calculations for heat exchangers. Some account has had to be made for the temperature loss due to the conduction mechanism along the fins. It has been usual to compensate for this loss by applying a fin efficiency to the fin side film coefficient. This fin efficiency factor complicates the determination of film coefficients because the efficiency is often intricately involved in the coefficient calculation.

A better concept—the use of a fin resistance to be applied in the overall coefficient of heat transfer relation like any other resistance such as the fouling factor or tube wall resistance—was presented in Part 1 of this series. (See Equation 2, PETROLEUM PROCESSING, Feb. 1957, p. 73.)

These fin resistance values are determined by rearranging the application of the fin efficiency values mentioned above. This rearrangement separates the fin resistance from the film coefficient determination and simplifies design of low-finned exchangers.

In this second part of the series, the operation of full size condensers in a petrochemical plant is reported. Design methods are outlined and the methods checked against the actual performance of the condensers.

Low-Finned Tubing in a Petrochemical Plant

The operation of an industrial installation of low-finned tubing was reported by Ames and Newell.(1) They described finned tube condensers in the butylene

*For a complete biography of Mr. Newell, see "Meet the Author" with Part I of this series, February PETROLEUM PROCESSING, p. 77.

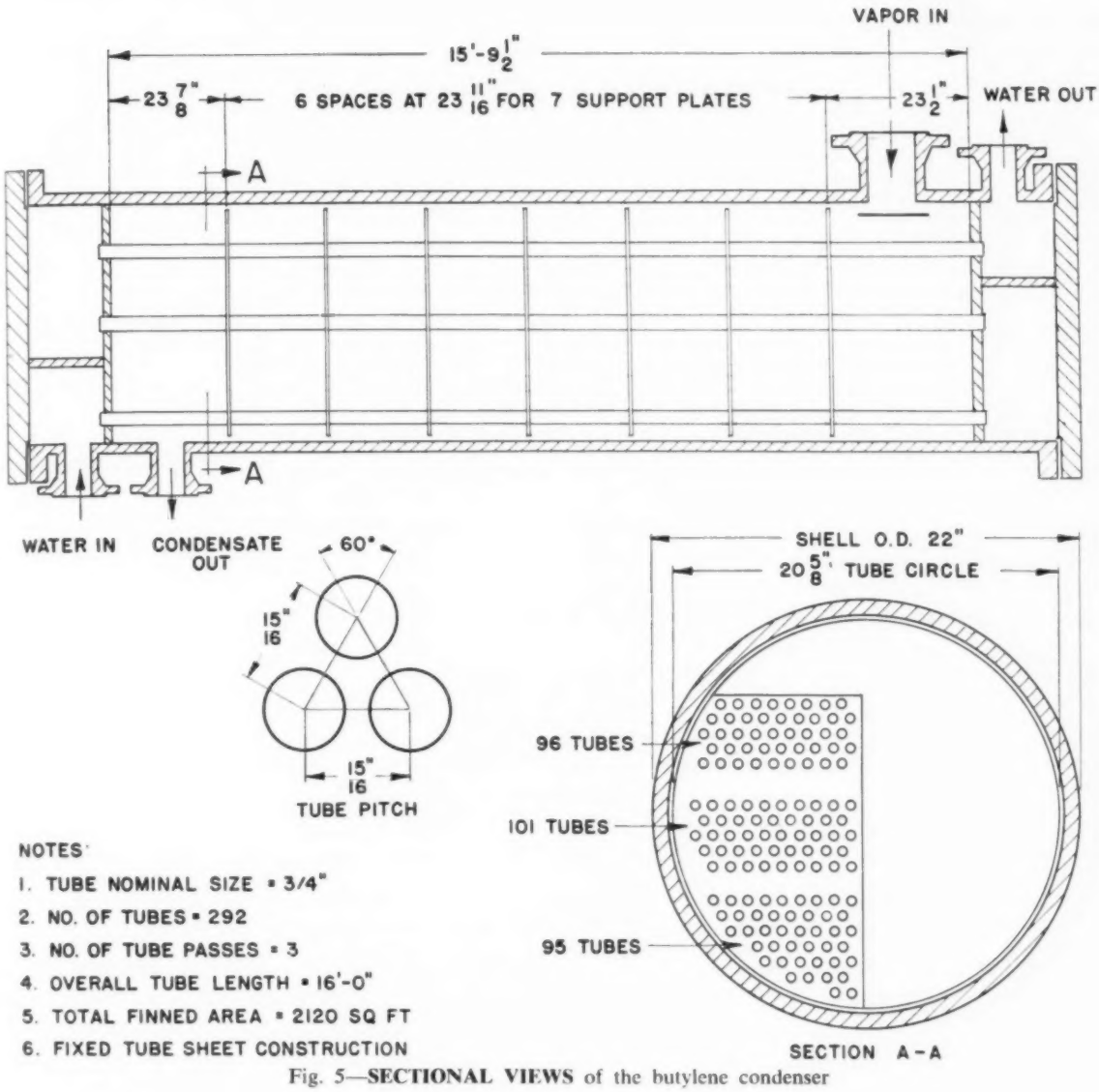


Fig. 5—**SECTIONAL VIEWS** of the butylene condenser

concentration plant at Polymer Corp. Ltd., Sarnia, Ont. These units were installed in November, 1950, and were tested under varied operating conditions. The butylene condensers, subcoolers, and exchangers are shown in the drawings.

These exchangers are serving as a reflux condenser for a tower which fractionates between acetone-water and C_4 hydrocarbon. The vapor, condensed on the fin side, consists of approximately 90 mol % C_4 unsaturates (mostly n-butylene), 9 mol % C_4 saturates (mostly n-butane), and 1 mol % acetone. The vapor is at its dew point (136°F and 93 psia) and the service requires that the condensate be subcooled to 92°F. The cooling water temperature varies from winter to summer in the range 34-72°F. The hydrocarbon stream contains no fouling or corrosive components.

The unit consists of six horizontal exchangers, three condensers and three subcoolers. The condensers are connected in parallel on the hydrocarbon side, and each condenser has a subcooler in series with it as shown in Fig. 4. Water is supplied independently to the tubes of each exchanger. The condensers are tubed with 90/10 cupro-nickel low-finned tubes, and the subcoolers with Admiralty bare tubes.

The unit was originally designed to operate with one condenser-subcooler combination acting as a spare for the two others, so that the tubes could be cleaned with the tower in operation. It was intended that the condensers would have enough capacity to condense the vapor, and that all subcooling would take place in the lower shells.

The design conditions for the service were as follows:

Hydrocarbon total flow, lb/hr	136,200
Hydrocarbon vapor inlet temperature, °F	136
Hydrocarbon condensate temperature, °F	92
Water inlet temperature, °F	70
Water side fouling factor	0.001
Hydrocarbon side fouling factor	0.0005

The construction and details of the condensers are shown on Fig. 5.

The condensers have considerably more capacity than anticipated in the original design and are now normally operated to carry both the condensing and subcooling loads. However, for test purposes, it was possible to

Table 2A—Performance of Butylene Condenser

Case	Hydrocarbon flow lb/hr	Hydrocarbon °F in	Hydrocarbon °F out	Cooling water veloc. fps	Cooling water °F in	Cooling water °F out	Duty, 1000 Btu/hr condensing	Duty, 1000 Btu/hr subcooling	Overall coeff, *Uo* measured	Time since tubes cleaned, months
1A	70,900	135	132	4.5	36	116	9,950	130	97	6
2A	70,900	135	98	6.1	36	102	9,950	1,645	97	6
1B	69,500	136	128	6.2	69	125	9,760	348	155	3
2B	69,500	136	92	8.0	69	119	9,760	1,812	158	3
3	99,100	138	133	5.9	49	131	13,790	300	206	3
4	99,700	138	92	9.4	49	110	13,950	2,730	156	3

Table 2B—Derived Values for Butylene Condenser

Case	Fouling Factors Assumed: Shell Side	Fouling Factors Assumed: Tube Side	Proportional Flow Areas: Condensing	Proportional Flow Areas: Subcooling	Subcooling Film Coefficient	Tubes for Condensing	Condensing Film Coefficient
1A	0.0005	0.001	——	Not Calc.	—	292	667
2A	0.0005	0.001	0.870	0.130	245	254	593
1B	0.0005	0.0005	0.902	0.098	284	263	1348
2B	0.0005	0.0005	0.860	0.140	233	251	1790
3	0.0005	0.0005	——	Not Calc.	—	—	——
4	0.0005	0.0005	0.861	0.139	287	251	1158

operate the unit so that either condensation alone or condensation plus subcooling took place in the condenser.

Operating data are presented for these four cases:

1—Two condensers in parallel, in condensation service only

2—Two condensers in parallel, in condensation plus subcooling service

3—One condenser, in condensation service only, operating at 70% of design condensation load for whole unit

4—One condenser, in condensation plus subcooling service, operating at 70% total design load for the whole unit.

The data for Cases 1 and 2 are presented for service water at winter and summer temperatures. Table 2 summarizes measured and calculated data for the four test conditions mentioned above.

The exchangers had been operating 2½ years at the time of reporting. Fouling on the shell side had been negligible and the fins had never been cleaned since the condensers went on stream. For the purposes of calculation, the shell-side fouling was assumed as equivalent to a factor of 0.0005. The tubes were cleaned at six month intervals. Because of the relatively high water velocity (4-9 fps), fouling on the tube side was not severe.

The high measured overall coefficient of Case 3 was associated with a low log mean temperature difference which was the result of the high water outlet temperature. The unit was checked on several occasions to confirm the temperatures. It is generally known that the log mean temperature difference is not a true representation of the actual ΔT in a condenser. Because of this situation, the values for Case 3 were meaningless and were not extended through the complete calculations.

The film coefficients for condensing derived by the proportioning of heat loads and heat transfer areas and by the subtraction of individual coefficients and resistances from the overall resistance have been plotted in Fig. 6, using the Case number as the identifying symbol.

The condensate loading per foot of finned length was used to calculate the W_l values in Table 3 (i.e., total weight of hydrocarbon condensed divided by the total exposed length of finned tube). *This gave a direct comparison with the experimental single tube data.*

The calculated values for the condensing film coefficients shown in Table 2B are dependent on the assumed values for the fouling factors. The fouling factors shown were picked for the Ames and Newell[1] paper to show that when normal design values are used, the calculated overall coefficients would be reasonable and conservative representations of operating coefficients. It was not intended that the fouling factors should be the best estimate of actual fouling.

In fact, in Cases 1B, 2B, 3 and 4 there is good evidence, from appearance of the tubes and history of the operation, and particularly with respect to water velocity, that the actual fouling factor is lower than that assumed, in which case the condensing film resistance is higher and the coefficient lower than shown in Table 2B. In cases 1A and 2A, where the run length was longer, and water velocities lower, it is quite possible that the assumed tube side fouling factors are low, which would result in a high calculated value of condensing film resistance and consequently, a low coefficient.

In a service like this, where the fouling resistance is of the same order, or larger than the film resistance, a small change in the fouling factor can make quite a difference to the condensing film coefficient derived as it is for Table 2B. For example, in Case 1B, the derived coefficient would have fallen close to the correlating curve if the fouling factor chosen had been 0.0002 instead of 0.0005. Therefore, there is reason to believe that if it had been possible to use the true values of fouling resistance in these derivations, that the data points would have fallen close to the correlating line on Fig. 6.

An Equation for Calculating Condensing Coefficients

Beatty and Katz[2] presented data for seven fluids condensing on two different single low-finned tubes having 16 fins/inch. Young, Katz and Balekjian[15] re-

cently published data for the condensation of Freon-114 on a low-finned tube having 19 fins/inch.

The data of these authors was correlated by the Temperature Difference Method[12,14]. An equation for this correlation was developed by Robinson and Katz[10] as a modification of the Nusselt equations containing an empirical equivalent diameter for the low-finned tubing which was confirmed as satisfactory by the experimental work mentioned above.

A more popular method of calculating condensing film coefficients is in terms of the condensate loading on the tubes. All of the data for low-finned tubes by the authors mentioned above has been recalculated for correlation by the Condensate Loading Method. The recalculated data is reported in Table 3. Fig. 6 is a plot of h experimental vs. a from Table 3. The correlating line with a slope of ⅓ was located by the method of least squares.

The equation for condensing coefficients on Single Low-Finned Tubes by the Condensate Loading Method (the equation of the correlating line of Fig. 6) is Equation (9).

$$h_o^r = 0.616\left[\frac{k_f^3\rho_f^2 g}{\mu_f}\right]^{1/3}\left[\frac{A_o}{D_{eq}}\right]^{1/3}\left[\frac{1}{W_t}\right]^{1/3} \quad \ldots\ldots\ldots (9)$$

The multiplying factor of 0.616 represents a 5.4% difference of experimental results from the theoretical value of 0.651. This close approximation verifies the empirically derived D_{eq} as satisfactory.

A very important feature of low-finned tubing is illustrated by the data in Table 3. Tubes No. 1 for

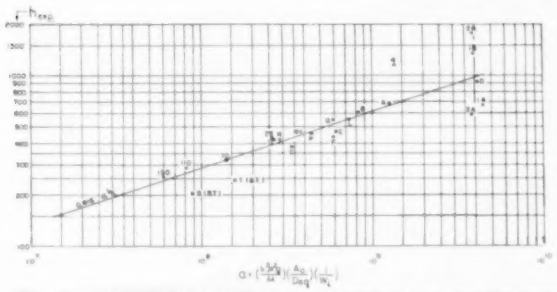


Fig. 6—**CORRELATION** of condensing film coefficients of heat transfer for several fluids condensing on a low-finned tube

Group F and No. 2 for Group S are both condensing dichlorodifluoromethane (F-22). The ratio of condensate loading for low-finned to bare tube is 2.43/1, yet the condensing coefficient for the low-finned tube is more than twice the value of that for the bare tube. The difference is chiefly attributable to the higher value of $(A_o/D_{eq})^{1/3}$ for the low-finned tube. For the same condensate loading, the ratio of coefficients for Tubes 1 and 2 should be the same as the ratio of their values of $(A_o/D_{eq})^{1/3}=(51.42/3.142)^{1/3}=2.54$ (A_o/D_{eq} for bare tube $=\pi D \times 1/D=\pi$).

This increased coefficient coupled with the increased area of low-finned tubes means that there is a real bonus in heat transfer when they are used in condensers.

The equation of the Condensate Loading Method com-

Table 3—Calculations for Condensate Loading Method

Test runs Group	Tube	Fluid	$k_f^3\rho_f^2 g/\mu_f$	A_o/D_{eq}[1]	Condensate loading, W_t lb/hr x ft	$1/W_t$	a[3]	h exp.	Source
A	1	MeCl	19.9 x 10^6	51.42	81.2	0.0123	12.6 x 10^6	685	
B	1	MeCl	18.8 x 10^6	51.42	116.8	0.0086	8.28 x 10^6	613	
C	1	n-C_5	4.65 x 10^6	51.42	70.8	0.0141	3.38 x 10^6	381	
D	1	SO_2	67.8 x 10^6	51.42	83.6	0.0120	41.7 x 10^6	920	
E	1	C_3	6.04 x 10^6	51.42	51.0	0.0196	6.10 x 10^6	467	
F	1	F-22	10.4 x 10^6	51.42	91.3	0.0109	5.86 x 10^6	438	
L	1A	n-C_4	5.67 x 10^6	49.66	38.6	0.0258	7.28 x 10^6	553	Data of Beatty & Katz
M	1A	n-C_4	6.66 x 10^6	49.66	55.5	0.0180	5.96 x 10^6	505	Data of Beatty & Katz
N	1A	n-C_4	5.59 x 10^6	49.66	73.2	0.0136	3.79 x 10^6	465	Data of Beatty & Katz
O	1A	n-C_4	5.81 x 10^6	49.66	108.2	0.0092	2.66 x 10^6	422	
P	1	n-C_4	5.87 x 10^6	51.42	68.2	0.0146	4.42 x 10^6	458	
Q	1	n-C_4	5.58 x 10^6	51.42	48.3	0.0207	5.93 x 10^6	557	
R	1	n-C_4	5.77 x 10^6	51.42	103.4	0.0097	2.87 x 10^6	424	
S	2[1]	F-22	10.7 x 10^6	3.142	37.5	0.0268	8.98 x 10^7	201	
T	2[1]	F-22	11.5 x 10^6	3.142	23.0	0.0435	1.58 x 10^8	246	
25 psig	19 fpi	F-114	3.71 x 10^6	71.78	102.9	0.0097	2.59 x 10^6	429	Data of Young, Katz, & Balekjian
70 psig	19 fpi	F-114	2.79 x 10^6	71.78	143.7	0.0070	1.39 x 10^6	321	Data of Young, Katz, & Balekjian
110 psig	19 fpi	F-114	2.48 x 10^6	71.78	219.5	0.0046	0.810 x 10^6	288	Data of Young, Katz, & Balekjian
150 psig	19 fpi	F-114	2.22 x 10^6	71.78	271.0	0.0037	0.604 x 10^6	254	Data of Young, Katz, & Balekjian
1A	19 fpi	n-C_4	5.32 x 10^6	69.43	8.28[4]	0.121[4]	44.6 x 10^6	667	
2A	19 fpi	n-C_4	5.32 x 10^6	69.43	9.55	0.105	38.7 x 10^6	593	
1B	19 fpi	n-C_4	5.32 x 10^6	69.43	9.37	0.107	39.5 x 10^6	1,348	Data of Ames & Newell
2B	19 fpi	n-C_4	5.32 x 10^6	69.43	9.47	0.106	39.2 x 10^6	1,790	Data of Ames & Newell
3	19 fpi	n-C_4	5.32 x 10^6	69.43	—	—	—	—	Data of Ames & Newell
4	19 fpi	n-C_4	5.32 x 10^6	69.43	27.2	0.0368	13.6 x 10^6	1,158	Data of Ames & Newell

(1) Bare tubes.

(2) Values of A_o/D_{eq} for the data of Beatty & Katz; and Young, Katz, et al. are for experimental tubes. Value for data of Ames & Newell is from Table 1 (Part I, PETROLEUM PROCESSING, Feb., 1957, p. 73).

(3) $a=\left(\frac{k_f^3\rho_f^2 g}{\mu_f}\right)\left(\frac{A_o}{D_{eq}}\right)\left(\frac{1}{W_t}\right)$

(4) Condensate loading in data from Ames & Newell is loading per ft of finned length, as for the single tubes.

bined with the fin resistance technique of calculation makes the determination of condensing coefficient values on low-finned tubing as simple as possible.

Multitube Condensing

There is only one presentation of experimental data for condensing, in what amounts to a multitube arrangement. Katz and Geist[5] reported findings for four fluids condensing on six finned tubes in a vertical row.

Heat transfer coefficients for condensation vary inversely as the thickness of the liquid film on the cooling surface. An increase in the loading, i.e., the amount condensed per unit area, means an increase in film thickness and a reduced coefficient. The descent of the condensed liquid from tube to tube in a multitube unit causes a film thickening, and, therefore, the film coefficient should decrease as the liquid film thickness increases from top to bottom of the tube bank.

The conventional method of correcting for this multitube effect is to use the condensate loading per condensing stream. An average number of condensing streams is determined for the tube bank. A condensate loading equal to the total pounds per hour condensed, divided by the tube length and the number of condensing streams, is calculated. This stream loading is used in an equation like (9) to determine a film coefficient which is applied to all the condensing surface in the heat exchanger.

The data of Katz and Geist[5] showed that the film coefficients for condensing on low-finned tubing did not decrease nearly as much as predicted by this "condensate loading correction." Nor did the condensing film coefficients for butylene reported in Table 2 all fall below the single tube performance line, but lie grouped around it.

A modified correction procedure for multitube condensing was devised by Young, Katz and Balekjian[15] from the data of Katz and Geist. The method is to apply the conventional correction of using the loading for a condensing stream, and then multiplying by a correction factor to increase to a more realistic value. An analysis of the procedure reveals, however, that it can be reduced down to multiplying a single tube coefficient by about 0.8.

The commercial publications[12,14] also presented correction factors which were multipliers to be applied to single tube coefficients. The basis on which these correction factors were established is somewhat less definite than the Young et al corrections mentioned above.

An equation for Multitube Condensing by the Condensate Loading Method can thus be given as:

$$h_o'' = 0.616 C_1 \left[\frac{k_f^3 \rho_f^2 g}{\mu_f}\right]^{1/3} \left[\frac{A_o}{D_{eq}}\right]^{1/3} \left[\frac{1}{W_l}\right]^{1/3} \quad \text{(9a)}$$

With C_1 selected at 0.8 according to the Young et al correction, this equation can safely be used for light hydrocarbons, naphtha cuts and organic chemicals.

A Procedure for Condenser Design

To use Equation (9a) for the Condensate Loading Method of determining coefficients for the design of a vapor condenser, a procedure is presented below. To illustrate the procedure, the sample problem from the commercial publications[12,14] has been recalculated.

The procedure to be presented is applicable only to the condensing of a single component vapor. For a partial condenser or a condenser where considerable subcooling takes place, the method must be modified.

It is required to condense 100,000 lb/hr of propane vapor at its dew point of 138°F at 300 psia, with 705 USgpm of 85°F water (leaving at 125°F). The heat duty is 14,100,000 Btu/hr. Fouling factors are 0.001 for the shell side and 0.002 for the tube side. The tubing to be used is ¾ in. O.D. x 16 BWG Admiralty, 16 ft 0 in. long with 15 ft 0 in. finned portion. Tubes are spaced in a 1-in. square pattern.

The step-wise procedure follows:

1: Assume a value of U_d and determine the surface required from Equation (1). With the area data on our specified tube from Table 1, determine the number of tubes required and make a preliminary layout.

Assume: U_d = 85.5 (third trial)
A_o = 0.438
LMTD = 28.3°F.
L_{fl} = 15 ft. 0 inches (finned length)
No. of tubes = 14,100,000/(85.5 x 28.3 x 15 x 0.438)
= 886

The total of 886 tubes, ¾-in. O.D. in a 1-in. square pattern, require a 37-in. shell, assuming four tube passes.

2: Evaluate all the resistances in Equation (2) except $1/h_o''$ and r_f. Substract the sum of the resistances from $1/U_d$.

Water velocity = (705 x 4 x 1.57)/886
= 5.01 fps.
h_{water} = 1305
Σr = 0.001 + 0.00025 + (3.28/1305) + 3.28 x 0.002 = 0.01032
$1/U_d - \Sigma r$ = 0.0117 − 0.01032
= 0.00138

3: Evaluate the grouping of physical properties:

$$\left[\frac{k_f^3 \rho_f^2 g}{\mu_f}\right]^{1/3}$$

as 826 for propane at 138°F.

4: $(A_o/D_{eq})^{1/3}$ from Table 1 for ¾-in. O.D. Admiralty is 4.11.

5: Determine the tube loading.

$W_l = W_{sc}/(n_{tc} L_{fl})$
= 100,000/(886 x 15)
= 7.5 lb/(hr x ft)
$(1/W_l)^{1/3}$ = 0.510

6: Select the multitube correction as a multiplier of 0.8 after the method of Young et al.[15]

7: Calculate $h_o'' = 0.616 \times 826 \times 4.11 \times 0.510 \times 0.80$
= 855

8: Sum, $1/h_o''$ and r_o and determine the modified coefficient:

$1/h_o''$ = 0.00117
r_o = 0.001
sum = 0.00217
Modified coefficient = 460

9: Read the Resistance from Fig. 4: r_f = 0.000119.

10: The sum of $1/h_o'' + r_f$ must be equal to or less than the difference between $1/U_d$ and the Σr value from Step 2: i.e., less than 0.00138.

$1/h_o'' + r_f$ = 0.00117 + 0.00012
= 0.00129, which is less.

Therefore, design selection is satisfactory.

DU PONT

Things for Better Living ... through Chemistry

PETROLEUM ENGINEERING NEWS

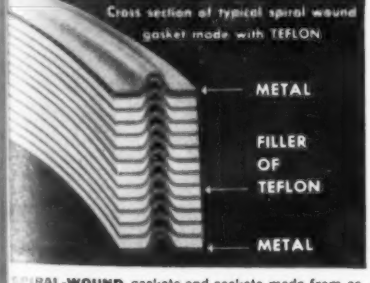
LATEST PROPERTY AND APPLICATION DATA ON

TEFLON® tetrafluoroethylene resin

Gaskets and packings of TEFLON® resist corrosives and high temperatures...reduce downtime

PACKINGS of TEFLON provide uniform packing performance and long service life. Solid packings are impervious to liquids and gases. Low frictional coefficient of TEFLON reduces torque . . . increases mechanical efficiency. Impregnated asbestos packings and plastic packings are also available.

ENVELOPE GASKETS of TEFLON consist of a soft filler covered by a jacket of TEFLON. They are used for sealing large diameters and where bolting pressures must be limited, as in glass-lined equipment and pipe made from ceramics.



SPIRAL-WOUND gaskets and gaskets made from asbestos and glass cloth impregnated with TEFLON are used in high-pressure installations such as pipe joints, reaction kettles, steam couplings, pump bodies, pressure tanks.

Du Pont TEFLON is unaffected by petroleum distillation products, catalysts and reagents. For example, TEFLON is the only packing material used successfully in a 3,600-rpm pump handling highly corrosive butyl extract. This mixture of sulfuric acid and petroleum fractions is typical of the corrosive refinery fluids so easily handled by TEFLON.

All types of gaskets and packings are available in TEFLON. Most of the *mechanical* properties of solid TEFLON are comparable to those of the best grades of rubber-bonded compressed asbestos. Gasket design for the two materials is therefore similar. TEFLON has a naturally slippery surface. For this reason, less torque is needed to turn shafts or stems equipped with packings made of TEFLON, even under high gland pressures. TEFLON compounded with additives such as asbestos, bronze, calcium fluoride, glass fiber and graphite can be used where special mechanical properties are required.

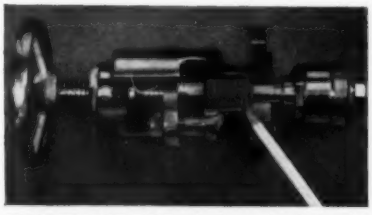
TEFLON tetrafluoroethylene resin is inert to nearly all chemicals and solvents in commercial use. The few exceptions to this include attack by the alkali metals under certain conditions. At high temperatures and pressures, halogens and certain halogenated chemicals and solvents may also affect TEFLON. The mechanical strength of TEFLON is high over a wide range of temperatures. This durable material is rated for use up to 500° F. and displays excellent properties at very low temperatures. Seals, bearings, packings and other components of TEFLON operate reliably year after year. Maintenance and replacement costs go down. Productive capacity is increased.

Wherever you have the problem of handling corrosive liquids or gases, especially at high temperatures, Du Pont TEFLON may well be the material you need for cost-saving operation. Find out what TEFLON can do for you by mailing the coupon below.

TEFLON®

is a registered trademark . . .

TEFLON is the registered trademark for Du Pont tetrafluoroethylene resin, and should not be used as an adjective to describe any other product or any component part; nor may this registered trademark be used in whole, or in part, as a trade name for any other product.



USED IN VALVE PACKING of petrochemical equipment, TEFLON offers outstanding resistance to heat and corrosives. Valves with packings of Du Pont TEFLON successfully handle nitric acid at 365° F. and dry chlorine gas at 100 lb./sq. in.

SEND FOR INFORMATION

Mail this coupon for additional property and application data on Du Pont TEFLON tetrafluoroethylene resin.

E. I. du Pont de Nemours & Co. (Inc.), Polychemicals Dept.
Room 883, Du Pont Building, Wilmington 98, Delaware

Please send me more information on Du Pont TEFLON tetrafluoroethylene resin. I am interested in evaluating this material for_____

Name_____

Company_____ Position_____

Street_____

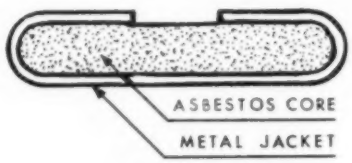
City_____ State_____

Type of Business_____

In Canada: Du Pont Company of Canada (1956) Limited, P. O. Box 660, Montreal Quebec

Compressibility controlled* gaskets for HIGH PRESSURE HIGH TEMPERATURES

AsBesteel GASKETS



*** COMPRESSIBILITY CONTROLLED**

Controlled compressibility is an exclusive feature available in our metal jacketed gaskets. Our special process of varying the density of the asbestos core makes possible a choice of softer or harder gaskets within the same gasket dimensions.

F & T AsBesteel combines the compressibility of an asbesto core with the strength of a metal jacket for high temperatur and high pressure requirements. They are recommended fo temperatures up to 950° F and pressures to 2000 psi.

AsBesteel construction provides ruggedness and resilience PLU unusual compressibility. It makes possible perfect sealing wit considerably lower bolting pressures than is possible with spira wound gaskets. AsBesteel gaskets will fill imperfections i rough finished flange surfaces.

Even at extreme changes in temperature the unique qualities o AsBesteel gaskets assure constant sealing. Service men lik them because they do not stick to flange surfaces. High spee manufacturing methods make them very low in price.

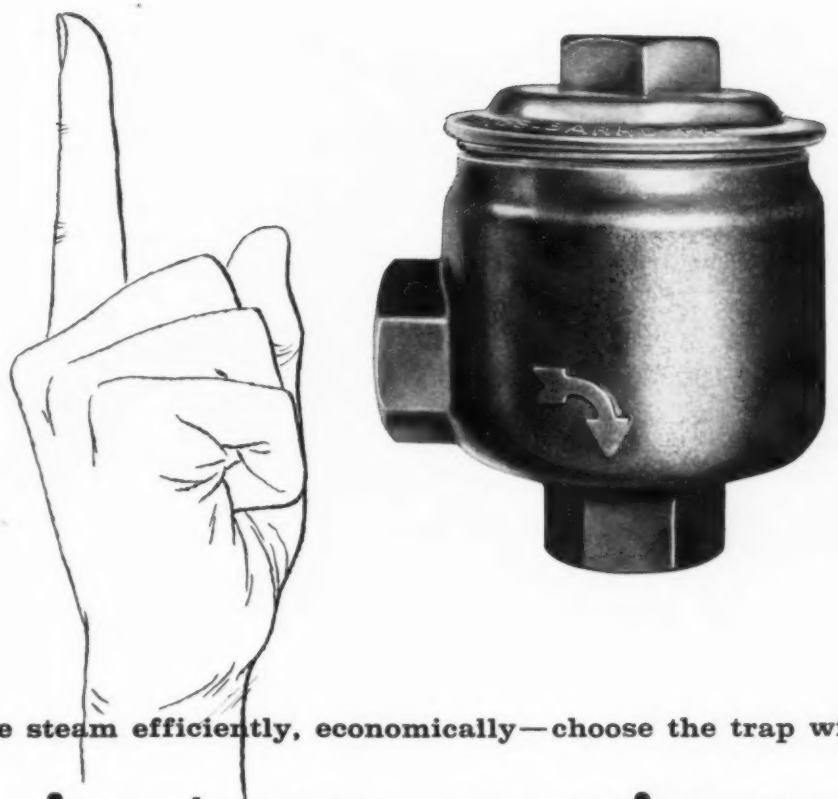
A choice of steel, copper or monel is offered as standard. Othe metal or special finishes and coatings are also available.

MAIL BLUEPRINTS FOR QUOTATION BY RETURN MAIL OR PHONE ABOUT YOUR SPECIFIC PROBLEM

GASKET PIONEERS SINCE 1910

FAUL & TIMMINS, inc

695 SENECA STREET BUFFALO 10, N.Y.



use steam efficiently, economically—choose the trap with . . .

just one moving part

. . . for easy maintenance

After all, a steam trap *should* be simple. Its job of discharging condensate and air from steam lines and equipment, is a simple one. But its importance shouldn't be overlooked. On its effectiveness can rest your economical use of steam . . . the efficiency of your process operations.

With Nicholson steam traps there's just one moving part. Nothing to go wrong. But with all their simplicity, Nicholson traps have the greatest capacity of any trap their size. Plenty of other important features, too, and it'll be well worth your while to check them.

- **Powerful valve action**
- **Tight, positive shutoff**
- **No dribbling, no steam waste**
- **Each unit service tested**

Specify Nicholson, and be sure.

Write today for new Bulletin 10-55

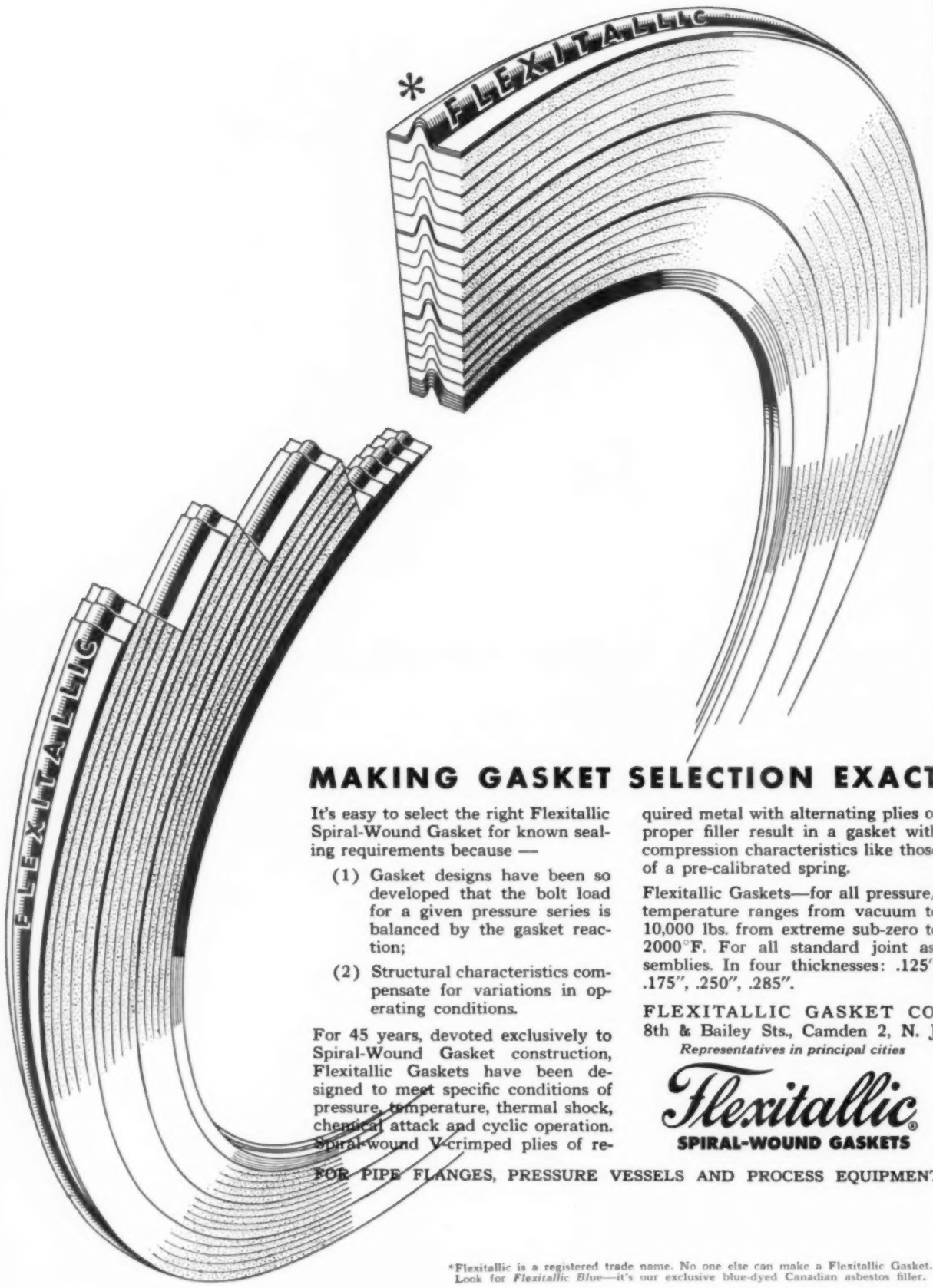
NICHOLSON

W. H. NICHOLSON and Company

TRAPS • VALVES • FLOATS • METAL PARTITIONS
LAUNDRY, DRY CLEANING AND PRESSING MACHINERY

14 OREGON STREET, WILKES-BARRE, PA. • SALES AND ENGINEERING OFFICES IN 98 PRINCIPAL CITIES

(To obtain more data on advertised products see page 170)



MAKING GASKET SELECTION EXACT

It's easy to select the right Flexitallic Spiral-Wound Gasket for known sealing requirements because —

(1) Gasket designs have been so developed that the bolt load for a given pressure series is balanced by the gasket reaction;

(2) Structural characteristics compensate for variations in operating conditions.

For 45 years, devoted exclusively to Spiral-Wound Gasket construction, Flexitallic Gaskets have been designed to meet specific conditions of pressure, temperature, thermal shock, chemical attack and cyclic operation. Spiral-wound V-crimped plies of required metal with alternating plies of proper filler result in a gasket with compression characteristics like those of a pre-calibrated spring.

Flexitallic Gaskets—for all pressure/temperature ranges from vacuum to 10,000 lbs. from extreme sub-zero to 2000°F. For all standard joint assemblies. In four thicknesses: .125", .175", .250", .285".

FLEXITALLIC GASKET CO.
8th & Bailey Sts., Camden 2, N. J.
Representatives in principal cities

Flexitallic®
SPIRAL-WOUND GASKETS

FOR PIPE FLANGES, PRESSURE VESSELS AND PROCESS EQUIPMENT

*Flexitallic is a registered trade name. No one else can make a Flexitallic Gasket. Look for *Flexitallic Blue*—it's our exclusive blue-dyed Canadian asbestos filler.

GASKETS

are a small—even insignificant—part of the first cost of process equipment. As a result, their true importance is frequently overlooked. Yet, leaking joints from improper gasketing can cost petroleum processors millions of dollars every year. • Yesterday, moderate process conditions often made gaskets a secondary consideration. Normal materials of that day were adequate. • Today, however, new processes and more severe operating conditions have created needs for new materials and techniques. • This special 16-page report will tell you . . .

how to choose and use today's GASKETS in today's equipment

CONTENTS

what a GASKET is and how it works.....p. 96
five types of GASKETED joints.....p. 98
three forces acting on GASKETS.....p. 99
two factors in choice of GASKET material.....p. 98
what materials are available for GASKETS.....p. 100
a GASKET selection check list.....p. 101
what you need to know to choose the right GASKET.....p. 102
how metal GASKETS are constructed.....p. 104
GASKET design: 2 factors, 2 steps.....p. 106
special GASKET designs for special service....p. 108
how to get the most out of a GASKET.....p. 110

a special report by RON CANNON

Southwestern Editor

Petroleum Processing

Copyright, 1957, McGraw-Hill Publishing Co.

March, 1957

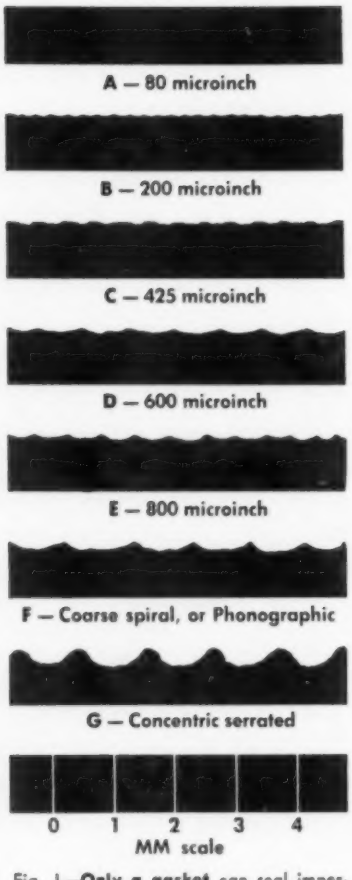

A — 80 microinch
B — 200 microinch
C — 425 microinch
D — 600 microinch
E — 800 microinch
F — Coarse spiral, or Phonographic
G — Concentric serrated
0 1 2 3 4
MM scale

Fig. 1—**Only a gasket** can seal imperfections left in flange finish by tools

what a GASKET is a

A GASKET is a packing designed for inclusion between rigid parts of a fluid container in essentially stationary relationship. Gasketing (collective) is material in sheet, strip, or bulk form, from which gaskets may be prepared. (Definitions from the American Society for Testing Materials.) Stated another way, a gasket is a static seal, used where there is no relative motion between jointed parts.

This definition differentiates between gaskets and other types of packings that seal between moving parts. The most common use of gaskets in refineries is in pipe flanges, manway openings, and similar circular mating parts. This will be taken as a representative example, although the same principles apply to all gasketed joints.

The gasket creates and maintains a tight seal between separable and rigid members of a mechanical assembly. Gasketed joints, the most commonly used, are easily assembled and dismantled.

There are three components of the gasketed assembly: 1) flange, 2) gasket, and 3) bolting.

The flange does not require a gasket for sealing if the mating flange faces are polished perfectly smooth and can be expected to remain in that condition throughout their lives. This precision, however, is usually impractical and always expensive. The inexpensive and easily replaceable gasket substitutes for costly machining and exacting assembly.

Machine finishes of standard pipe flanges are usually concentrically serrated or spirally grooved. (Fig. 1) Commercial serrations are 1/64-in. deep, with 32 serrations/inch. Commercial "smooth" finishes have 80-100 serrations/inch, about 0.0005-in. deep. No amount of bolt loading will make a metal-to-metal seal with these imperfections in the mating parts.

Gaskets provide the "give" that is needed to seal these joints. The gasket is squeezed by bolt pres-

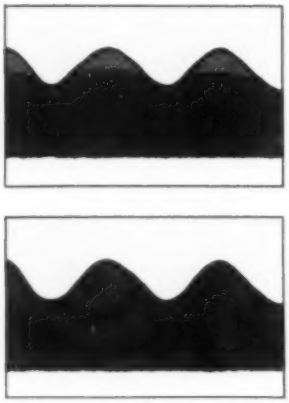
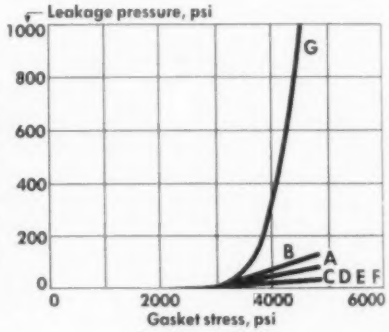
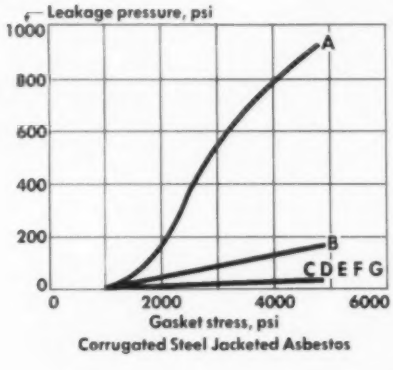
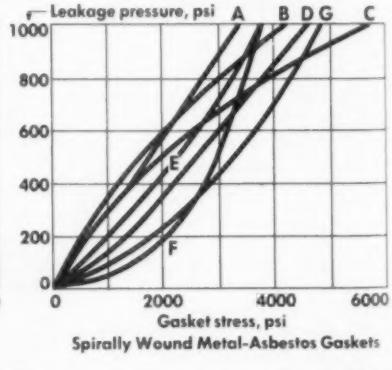


Fig. 2—**How flange finish** affects gasket performance. At a given bolt load, gasket makes good seal on smooth flange, has poor contact on rough flange

Fig. 3—**There is no universal gasket** material for all types of flange finishes. A flat copper gasket (chart at right) is totally unsuited for all except the relatively rough concentric finish **G**, for example. Corrugated steel jacketed asbestos on the other hand (chart below) works best with fine finish **A**. Another finish (chart below at right) has more versatility. See chart above for finish designations







is and how it works

sure on the flanges into imperfections in flange faces. (Fig. 2) This flow of gasket material fills the voids between mating parts and seals the joint. Complete filling of these voids is not necessary, depending on the pressure and surface tension of the fluid contained. Gas, however, has no surface tension, so complete filling of voids is a necessity for a gas-tight joint. In addition, the pressure exerted by the gasket on the flange faces must be greater than the fluid pressure trying to leak past it.

Flange finishes are important to gasket selection and greatly influence how well the gasket performs its sealing functions. Gasket material and flange finish must be matched to insure "wedging" action necessary to squeeze gasketing into flange irregularities. (Fig. 3) For deep serrations, or for flanges with extremely rough or pitted faces, a soft gasket might be required. The same purpose can be accomplished with a firmer gasket and higher bolt loading, however. The spiral, or phonographic, finishes (Fig. 4) are tough to seal because of the continuous leakage path from the fluid side of the joint. Likewise, the planed surface with parallel machine-tool marks is hard to seal because of relatively short, straight leakage paths. (Fig. 5)

Some surface roughness, however, is desirable on flange faces to keep the gasket from "walking out" of the joint, particularly when the gasket material is a smooth, flat metal, or when flanges are likely to become oily.

Bolting provides the pressure necessary to squeeze the gasket into these imperfections. This pressure must do two things: 1) provide sufficient total pressure to seal the joint, and 2) distribute this pressure evenly over the entire gasket contact area. (Fig. 6) Two large bolts might be sufficient *total* loading for a given gasket and pressure, but the joint will probably fail because the gasket will not seal over its entire area of contact. A number of smaller bolts, properly spaced, will be needed. Pressure on the gasket is always greatest close to the bolts, and least midway between.

There are two other methods of flowing a gasket into imperfections of mating parts: heat and attrition. These methods do not properly apply to flanged joints, but they are worthy of mention.

Heat flow of gaskets is typified by the leaded joint of bell-and-spigot cast iron piping. Further caulking of the poured joint creates additional flow by compression. Attrition is a combination of compression and a dragging action of the gasket as it rotates on sealing surfaces, filling voids by squeezing and dragging the gasket material into imperfections. Typical of this type flow is the sealing gaskets of a spark plug. Rough flange faces on this type flow are hard on the gasket, and will tear the material if too rough.

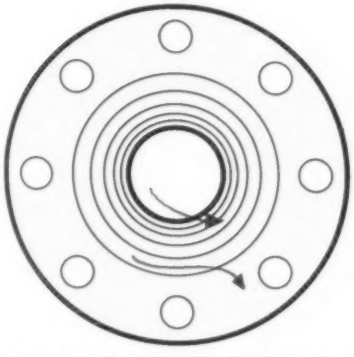


Fig. 4—**A phonographic finish** permits leaks through continuous path from fluid side of joint

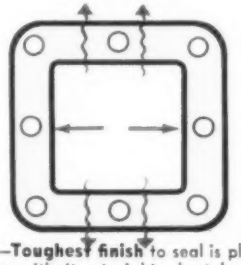


Fig. 5—**Toughest finish** to seal is planed surface, with its straight, short leakage paths

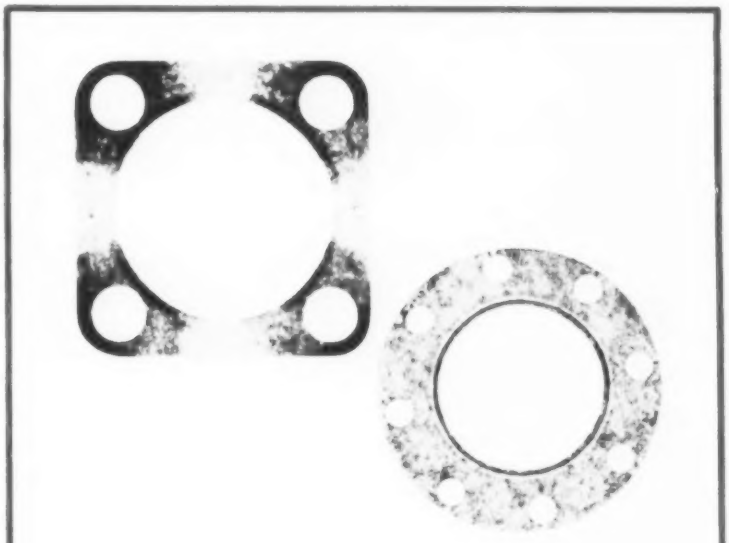
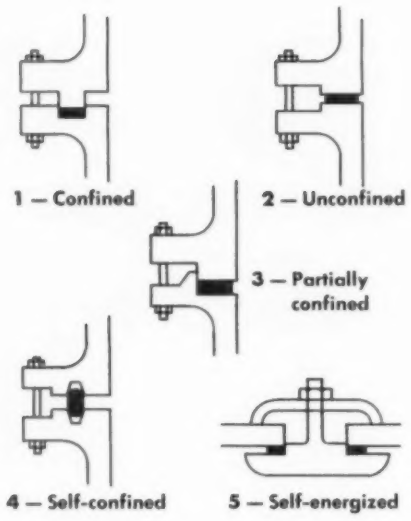


Fig. 6—**Why bolt loading is important.** In four-bolt flange most of load concentrates at bolts, there is little seating between bolts and leakage can occur. The eight-bolt flange has better load distribution, even seating, and will hold design pressures

five types of GASKETED joints



1—Confined joint: In this type, the gasket cannot flow except for slight clearances between flanges, and it cannot blow out. Typical are the tonque-and-groove joints. A large tongue-and-groove joint is useful where a non-metallic gasket is used for a wide contact area and low bolt load. The small tongue-and-groove is most often used with a metallic gasket and high bolt load.

2—Unconfined joint: Gaskets are free to flow and can be blown out if loading is too light or pressures excessive. Probably the most widely used today, this joint is best for moderate pressures and services.

3—Partially confined joint: Gaskets can move in one direction only, and there is some measure of protection against blowout. Small partially confined, seldom used today, are primarily for metal gaskets and high bolt loads. The more common large size is used most often with soft gaskets and on frequently-opened closures.

4—Self-confining joint: Most metallic gaskets are of this type, except the softer metals, which behave much like non-metals under high pressures and temperatures. Typical is the ring joint, with gaskets of various metals.

5—Self-energizing joint: This type does not depend on bolt pressure to make the joint, except for initial seating. Pressure on the gasket is caused by pressure of the fluid contained. Important factor in this joint: while internal pressure is being raised, the bolt load gradually reduces, sometimes to zero. Therefore, bolts must be tightened as fluid pressure rises.

two factors in choice of GASKET

RESISTANCE to mechanical forces is largely a function of the physical properties of the gasket. Each material has inherent limitations, but these characteristics can be improved by reinforcing inserts, combinations with other materials, variations in construction, or by the type of joint it seals. Mechanical forces are important to design of the complete joint, but the primary selection of the gasketing *material* will be governed by two factors:

1) Temperature of fluid or gas contained.

2) Nature of fluid or gas contained.

Temperature

Operating temperature will limit the choice of materials that may be used for the gasket. Non-metallic gaskets and those incorporating rubber, or the low-melting point metals, in their construction, are with few exceptions, limited to temperatures below 250° F.

The semi-metallic group, which comprises gaskets made of asbestos, with or without metal jackets, may be used at temperatures up to 850° F.

Over 850° F, only gaskets of the all-metal type should be used.

With very few exceptions, a material should not be used at temperatures higher than those recommended for its group.

Fluid Contained

Resistance to corrosion attack by the confined fluid or gas may limit the selection of the gasket material to the all-metal group, regardless of temperatures.

For a full study of the effects of various chemicals on a gasket material, the following factors must be given careful consideration.

1—Concentration of corrosive agents may have a decided effect upon the selection of a resistant gasket material. Dilute solutions are not necessarily less corrosive than those full strength; the reverse is often true. Example: sulfuric acid in concentrations over 90% may be handled with iron, yet below this concentration, rate of attack increases rapidly.

2—Purity of corrosive agent, or the absence of contaminating compounds. Dissolved oxygen in otherwise chemically pure water can cause rapid oxidation of high temperature steam generating equipment.

3—Temperature of the corrosive agent will influence the rate of attack. This is in addition to the temperature effect on the mechanical properties of the gasket.

4—Location of the gasket some-

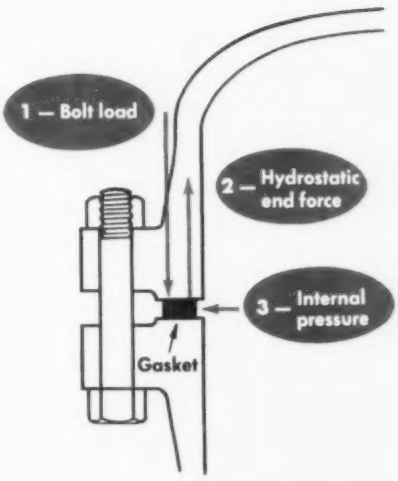
three forces act on GASKETS

TO FULLY understand how a gasket works, it is necessary to know something of the three main, definable, mechanical forces acting on the gasket, plus a host of lesser, indefinite forces.

1—Bolt load: Caused by the initial pressure of the bolts, this is the force that squeezes the gasket into the face voids to form the seal. The initial seating stress induced by this load varies with different gasket materials, and is the stress that experience has shown to be necessary to seat the gasket for any subsequent pressure. Until the pipe or vessel is subjected to internal pressure, this is the only force acting on the gasket.

2—Hydrostatic end force: When internal pressure is applied to the vessel or pipe, this force tries to force the flanges apart. This, of course, reduces the load on the gasket. The difference between the initial load and the hydrostatic end force is the residual force on the gasket. As has already been stated, this residual force must be sufficient to exert a pressure on the flange faces greater than the pressure of the fluid contained within the pipe or vessel.

3—Internal pressure acts in one other direction on the gasket. Pressure acting on that portion of the gasket exposed to the pressure side of the joint will tend to blow the gasket out of the joint. Resistance to this force is a function of the gasket material itself, and to a lesser degree, of the residual stress on the gasket. If the material is not suited to the pressure it contains, the gasket will rupture and blow out.



material

times affects its chemical resistance. Gaskets at or above the solution level, or in partially filled lines, may be more subject to attack than those below the surface.

5—Construction of the gasket may have a decided effect on its chemical resistance. A gasket jacketed with a thin sheet of metal might fail in a service where a solid design of the same metal would have reasonable life. Materials abnormally subject to stress-corrosion should not be used in a construction that relies upon highly localized stressing to form the seal.

The cost of materials for gaskets is not generally a factor in selection. However, where a closure will normally be opened quite frequently, a less expensive, though less resistant material may be satisfactory.

It is generally poor economy to use an inferior material where extra labor charges will be involved in replacing a failed gasket. Where closures are opened infrequently, the most resistant material available should be used. This may lead to a choice of a gasket made of a rare metal, such as platinum. Although the cost of this material is such that no one would seriously consider its use except where no other material is suitable, the end result of a platinum installation might be the cheapest in the long run. This is particularly true for critical services, and if the high salvage value of the gasket is taken into account.

Reaction between the gasket and the fluid *may* help seal a joint if it results in a slight swelling of the gasket. Otherwise it can lead to gasket failure and fluid contamination. A material that shrinks or dries out can also cause failure.

Other considerations may influence material selection, but to a lesser degree than the temperature and nature of the fluid.

Operating pressure does not generally have a direct influence on the selection of gaskets reinforced with metal. By defining the bolting, the internal pressure indirectly governs the choice of gasket construction. The strength of the gasketing material must be considered only when using a non-metallic gasket.

Operating cycle, vibration, and the frequency of dis-assembly will also affect the selection of the material. Sudden variations in operating conditions may require a very resilient material and design. The number of times a closure must be opened, may call for a gasket that can be reused many times.

In some installations, bolt relaxation caused by thermal expansion and creep should be considered. Expansion and contraction of the line or gasket and excessive bending moments on the flanges may prevent the use of an otherwise satisfactory gasket material and construction.

Consideration of all factors will usually result in narrowing possible choices down to one or two materials. The final selection can then be made on the basis of relative cost, availability, or personal experience. On tough problems, consult your gasket manufacturer.

what materials are available for GASKETS

GASKETS are made from an astonishing variety of materials. There are countless types, classes, styles, grades, and combinations of gasket materials.

This discussion, together with the table on the next two pages, will be a rundown on important materials, their uses and limitations.

It must be emphasized that this table is a compilation of general recommendations, based on information concerning common materials. Any generalization is dangerous if applied to a specific problem without a thorough consideration of all the variables involved. For example, almost any material listed may be specially compounded for resistance to almost any condition.

Rubber, both natural and synthetic, is very important, (Table 1). An ideal gasket material in many ways, rubber is elastic and squeezes into joint imperfections under light bolt loading. Its resilience maintains complete face contact over a wide range of loading, and variations in compounding makes the material suitable over a wide range of conditions.

It is generally available in sheet form in thicknesses from 1/32-in. to 1/4-in. Its suitability for gaskets is usually indicated in terms of its Durometer hardness. For gaskets, Duro numbers run from 35 to 95. Softer materials with a low Duro number are best for light bolt loads and rough flanges; higher Duro numbers with heavier bolt loads and smoother flange faces.

Rubber is not usually considered as gasketing for oil or solvent service. The synthetics, however, have greatly widened the range of rubber gaskets; they can be compounded for almost any service. When using rubber gaskets in oil service, however, always consider the aniline point of the oil contained (Fig. 7, opposite page), an index of its solvent action.

Asbestos is the workhorse of the gasket world, particularly where heat is involved. It is readily available in pressed sheets, woven cloth, reinforced sheets, and compounded with a variety of binders for specific services.

White asbestos, known technically as chrysotile, is mostly magnesium silicate with about 14% water of crystallization, which makes it a hydrated magnesium silicate. Up to 750-900° F, asbestos is relatively unaffected by heat. Above this range, water of crystallization is driven out, causing rapid loss of strength. At 1300° F, strength is just about gone. With little or no water asbestos is reduced to a powder.

Blue asbestos, or crocidolite, is about equal or inferior to white asbestos in most respects, but is more expensive. Heat limits are about the same.

Compressed sheets of asbestos fibers, compounded with one of a variety of binders, are made by vulcanizing the compound into a homogeneous structure, under high pressure. Sheet is usually 65-75% fiber, remainder binder. Natural and synthetic rubbers, common binders, will determine the chemical resistance of the gasket. Many users like a flexible gasket, one that's tough and not too brittle. The "feel" is not always a good indication of a gasket's qualities, however. Toughness and flexibility might be caused by a high percentage of binder, not enough fiber.

Asbestos is provided in woven cloth, also as gasketing material. Because asbestos has little strength of its own, it is always reinforced, either with cotton duck or fine brass wire. Reinforcing will determine heat resistance.

Plastics are the glamour girls among gaskets. Comparatively new, they are already stepping into the spotlight and stealing the show from some of the older performers. Complete range of usefulness is not yet known, but the performances of some widely used plastics have given some idea of what they'll do and where they are best used.

Generally speaking, the plastics have widened the range of the non-metallic gaskets. Where high temperatures and strong chemicals are impossible to hold with other non-metallics, the plastics have taken over. Information on some of the now-familiar plastics show that there are still some limitations, but most plastics can be specifically compounded for resistance to a wide variety of chemicals and services.

Other non-metallics include cork, vegetable fiber, and leather. These are important gasketing materials for specific services. They are generally not suited to heavy-duty plant use, but are widely used in light services throughout the refinery. Combinations, such as cork-and-rubber combine desirable properties of both components for special services (Fig. 8 below).

Metallic gaskets are the "heavyweights". At high temperatures and pressures, metals—alone, plated, or in combination with other materials—are used almost universally. Material, as usual, will be determined by temperature contained (Table 2) and corrosion resistance needed, and the construction will be governed, among other things, by the pressure rating of the joint.

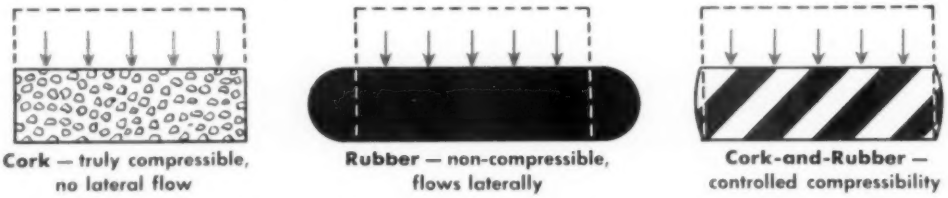
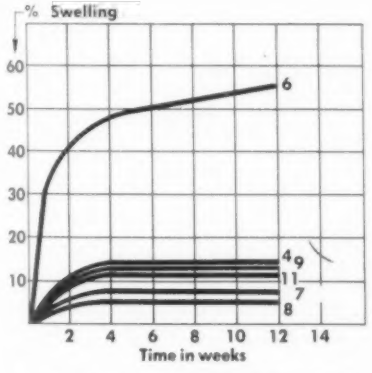

Cork — truly compressible, no lateral flow
Rubber — non-compressible, flows laterally
Cork-and-Rubber — controlled compressibility

Fig. 8—**Compressibility properties** of three types of gasket materials

Table 1—How various rubbers rate against important operating conditions

General Classification	Natural	Buna S	Buna N Low Swell	Buna N High Swell	Neoprene Type GN	Butyl Non-Oil Resistant	Thiokol Type PR-1	Thiokol Type ST	Silicone Rubbers
Specific gravity	0.93	0.94	1.00	1.00	1.25	0.91	1.35	1.35	1.2 to 2.6
Tensile strength, psi:									
Pure gum	3000	400	600	600	3500	3000	300	300	200 to 450
Reinforced	4500	3000	4000	4000	3500	3000	1500	1500	—
Tear resistance	Excellent	Poor-fair	Fair	Fair	Good	Good	Fair	Fair	Poor-fair
Abrasion resistance	Excellent	Good	Good	Good	Excellent	Fair	Poor	Poor	Poor
Aging:									
Sunlight	Poor	Poor	Poor	Poor	Excellent	Excellent	Good	Good	Good
Oxidation	Good	Fair	Fair	Fair	Good	Good	Good	Good	Very good
Heat, max temp °F.	300	250	300	300	300	300	160	160	450
Static (in storage)	Good	Good	Good	Good	Very good	Good	Fair	Fair	Good
Flex cracking resistance:									
Slow rate	Excellent	Good	Good	Good	Excellent	Excellent	Fair	Fair	Fair
Fast rate	Excellent	Poor	Poor	Poor	Excellent	Excellent	Poor	Poor	Poor
Compression set resistance	Good	Good	Very good	Very good	Poor	Fair	Poor	Poor	Good
Solvent resistance:									
Aliphatic hydrocarbon	Very poor	Very poor	Excellent	Good	Fair	Poor	Excellent	Excellent	Poor
Aromatic hydrocarbon	Very poor	Very poor	Good	Fair	Poor	Very poor	Good	Good	Very poor
Oxygenated solvent	Good	Good	Poor	Poor	Fair	Good	Fair	Fair	Poor
Halogenated solvent	Very poor	Very poor	Very poor	Very poor	Very poor	Poor	Poor	Poor	Very poor
Oil resistance:									
Low aniline	Very poor	Very poor	Excellent	Fair	Fair	Very poor	Excellent	Excellent	Poor
High aniline	Very poor	Very poor	Fair	Excellent	Good	Very poor	Excellent	Excellent	Good
Gasoline resistance:									
Aromatic	Very poor	Very poor	Poor	Good	Poor	Very poor	Excellent	Excellent	Poor
Non-aromatic	Very poor	Very poor	Fair	Excellent	Good	Very poor	Excellent	Excellent	Good
Acid resistance:									
Dilute (under 10%)	Good	Good	Good	Good	Fair	Good	Poor	Poor	Fair
Conc. (except nitric & sulf)	Fair	Poor	Poor	Poor	Fair	Fair	Very poor	Very poor	Poor
Low temp resistance, max °F.	—65	—70	—65	—65	—50	—65	—40	—65	—120
Permeability to gases	Fair	Fair	Fair	Fair	Very good	Very good	Good	Good	Fair
Water resistance	Good	Very good	Very good	Very good	Poor	Very good	Fair	Fair	Fair
Alkali resistance:									
Dilute (under 10%)	Good	Good	Good	Good	Good	Very good	Poor	Poor	Fair
Concentrated	Fair	Fair	Fair	Fair	Good	Very good	Poor	Poor	Poor
Resilience	Very good	Fair	Fair	Fair	Very good	Very poor	Poor	Poor	Good
Elongation, max %	700	500	500	500	500	700	400	400	300



Swelling of blackloaded neoprene in oils of various aniline points.

Oil No.	Type of Oil	Aniline pt. °C.
6	SAE 30 motor	77.7
9	SAE 30 motor	107.0
4	SAE 30 motor	109.0
11	SAE 30 motor	109.5
7	SAE 30 motor	110.8
8	SAE 30 motor	119.8

Table 2 — Maximum service temperatures of gasket materials in oxidizing atmosphere

(Temperature shown may be raised or lowered by operating conditions. These values are for general reference only)

Material	°F.
Tin	212
Lead	212
Zinc	212
Magnesium	400
Admiralty brass	500
High brass	500
Copper	600
Everdur	600
Aluminum	800
Stainless steel, 304	800
Stainless steel, 316	800
Rema iron	1000
Armco iron	1000
Low carbon steel	1000
Silver	1200
Gold	1200
Chrome moly steel, 502	1200
Chrome steel, 410	1300
Nickel	1400
Monel	1500
Stainless steel, 347	1700
Inconel	2000
Hastelloy, A or B	2000
Platinum	2300
Tantalum	3000

14 point Check List

You'll need this information in choosing a gasket:

- ☐ Fluid or gas to be sealed. If a chemical or corrosive, concentration must be known.
- ☐ Pressure to be sealed, both operating and test.
- ☐ Operating temperature range and cycle time.
- ☐ Type of flange.
- ☐ Nominal flange size and material.
- ☐ Actual flange dimension—ID, OD, and thickness.
- ☐ Type of flange facing.
- ☐ Contact surface dimensions.
- ☐ Condition of contact surface.
- ☐ Contact surface finish.
- ☐ Number and size of bolts, and bolt circle diameter.
- ☐ Bolt material.
- ☐ Limitations on gasket thickness.
- ☐ Number of times joint must be opened.

what you need to know

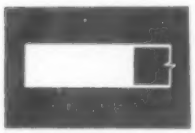
MATERIALS	CHARACTERISTICS	GENERAL USES	TEMP RANGE, F	LIMITATIONS
ELASTOMERS				
Natural	Tough, resilient. Duro hardness up to 80. Impervious. Not compressible.	For hot or cold water and water sol'ns, low pressure steam and gas, some dilute acids and alkalis.	−65 to +250	Low pressure only, except in confined joints. Not for strong acids. Never for oil or petroleum derivatives.
Buna-S	Better water resistance than natural. Duro up to 90. Good shear strength. Abrasion resistance. Not compressible.	General purpose for moist type joints: water, dilute acids and alkalis.	−70 to +250	Unsuited for gasoline, oil, solvents, concentrated acids.
Buna-N	Duro, 40-90, depends on cure. Resistance to abrasion, heat, compression set. High tensile strength. Nonadhesive.	Hot and cold water, steam, dilute acids and alkalis, gasoline, oil, aromatic and aliphatic solvents.	−65 to +300	Not for oxygenated or halogenated solvents. Poor resistance to light.
Neoprene	Duro 40-80. Resistant to abrasion & tear. Incompressible. Cannot vulcanize with sulfur.	Hot or cold water, gas, non-aromatics, oils with aniline pt over 225, some solvents, where sulf. corrosion likely.	−50 to +250	Not for aromatic gasolines. Low aniline pt oils cause swelling.
Butyl	Impervious. Good aging qualities. Good resilience at high temperatures, poor at room temperatures.	Water, steam, gas, alkalis, dilute acids. Excellent resistance to gas diffusion.	−65 to +250	Very poor against oils, solvents, gasoline.
Thiokol	Duro 50-90. Best solvent resistance any rubber. Good low temp properties. Low swell, shrinkage. Cannot be vulcanized with sulfur.	Hydrocarbons, esters, ethers, ketones, solvents, water, & where solvent resistance is second to phys. properties. Good for O-rings.	−65 to +212	Not for joints with high bolt loads. Not good against halogenated solvents.
Silicone	Resilient at high and low temp. Oxidation and weathering resistant. Good heat stability.	For joints where other rubbers are used, but at higher temp. Also for oils with high aniline point.	−100 to +450	Attacked by low aniline pt oils. Not for such solvents as gasoline, benzene. Relatively low tensile strength. Not for steam at high pressures.
PLASTICS				
Teflon	Good heat resistance. Very inert to chemicals. Incompressible. Non-resilient. Non-adhesive.	Best used in combination with other materials that give resilience to gasket.	−90 to +500	Some cold flow when first loaded. Decomposes to gas at 750 F.
Kel-F	Resistant to chemicals, solvents, weathering. Low cold flow. Resilient. Stays flexible at low temperatures. Is non-flammable.	For resistance to chemical attack. Unplasticized form has extreme chemical inertness.	−320 to +390 (unplast. form)	Plasticized form shows some shrinkage with some hydrocarbons, solvents, and hot water.
Polyethylene	Duro 45-95, depends on compounding. Resilience comparable to nat'l rubber. Stays flexible at low temp.	For chemical resistance and low temperature service.	−80 to +250	Not for glacial acetic acid, aniline (100%), formaldehyde, nitrobenzene, or HCl at high temperatures.
Phenolic resins	Strong and solid. Hard and impervious.	Combination gasket and insulation (electric) to restrict flow of stray currents.		Generally restricted to use in insulating flanges for control of electrolytic corrosion.
CORKS				
Cork compositions	Soft, resilient, and compressible. High friction properties.	For light duty at low bolt loads. Resists oil and aromatic solvents.	32 to 160	Not for sustained contact with water. Not for alkalis and corrosive acids. Moderate pressure only. Shrinks and hardens in some services.
Cork-and-rubber	Chemical resistance varies with rubber. Duro 25-90. High friction. Controlled compressibility.	In confined joints for metal contact of flanges and with low bolt loads. In unconfined joints for light duty only.	0 to 250	Base polymer governs resistance. Not for steam or high temp. Hard and unyielding below 0 F.

to choose the right GASKET

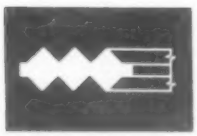
MATERIALS	CHARACTERISTICS	GENERAL USES	TEMP RANGE, F	LIMITATIONS
ASBESTOS				
White asbestos	Soft & pliable in woven cloth. Tough & durable in compressed sheets. Relatively non-compressible.	Good all-purpose for relatively high temp. For weak acids, alkalis, oil, solvents, steam, and hot water.	to 750	Binder or saturant governs resistance and temp range. Generally not for strong mineral acids.
Blue asbestos	About equal or inferior to white asbestos in physical properties.	Best for use against acids.	to 750	More costly than white asbestos. Temp range depends on binder or reinforcement.
FIBER				
Vegetable fiber	Firm & homogeneous. High tensile strength.	For seal and lube oils, water, non-corrosives. For lt or hvy bolt loads and smooth uniform flanges.	to 212	Generally for low press and moderate temp. Saturant governs solvent & oil resistance. Some types tend to harden & shrink with alternate wet & drying.
LEATHER				
Leather	Tough, porous, resistant to abrasion. Flexible at low temperatures.	For static seal in plain-faced flanges at low press. only. In confined joint for higher press. Best for dynamic seal.	−70 to +220	Permeability depends on tanning and impregnation. Never use with steam, acids, or alkalis. Quality is highly variable.
METALS				
Lead	Excellent corrosion resistance.	Widely used for sulfuric acid and other corrosives at temperatures under 212F.	to 212 (400 in a confined jt)	Excessive creep at higher temperatures.
Tin		For pure neutral solutions.	to 200	Strongly attacked by acids and alkalis.
Aluminum	High corrosion resistance. Oxide film forms protective coating.	Used for corrosion resistance. Good against hot, sulfur-bearing gases.	to 800	Slightly attacked by strong acids and alkalis, but this is not generally objectionable.
Copper, brass	Excellent corrosion resistance.	Good general-purpose gasket for corrosion resistance at moderate temperatures.	to 600	Attacked by oxidizing acids, wet NH_3, chlorine, sulfur. Embrittlement at high temp when exposed to H_2, CO, unless metal is deoxidized. Electrolysis sometimes objectionable.
Monel	High resistance to corrosion at all temperatures.	Versatile material, for most corrosives, acids, alkalis, and for steam and other high temperature applications.	to 1500	Attacked by strongly oxidizing acids & strong hydrochloric. Embrittlement in sulfur-bearing gases above 500F. Stress corr. likely with steam above 800 F.
Nickel	Somewhat lower all-around corrosion resistance than Monel.	Good against chlorine up to 950 F.	to 1400	Subject to embrittlement by steam over 800 F.
Iron, steel	SAE 1010 to 1020.	For joints with low gasket stress. For strong acids and most alkalis.	to 1000	Strong attack by sulfur-bearing gases over 600 F. Not for crude acids, high gasket stress causes corrosion.
Chrome steel	Type 502 (4-6 Cr, 5 Mo)	For resistance to oxidation. Good against steam. Widely used in ring type joints.	to 1200	Generally more corrosion resistant than iron.
	Type 410 (11-14 Cr)	Special use for resistance to oxidation at high temperature.	to 1300	Special purpose material only.
Stainless steel	Type 304 (18-8)	Most widely used gasket for corrosive service.	to 800	Attacked by sulfuric acid & wet halogens. Subject to intergranular corrosion after long service @ 800-1500 F.
	Type 347 (18-8,Cb stabilized)	For extremely high temp.	to 1700	Corrosion resistance is not raised by stabilization.
	Type 316 (18-8, with Mo).	For cases where additional corrosion resistance is required.	to 800	Subject to intergranular corrosion at 800-1500 F.

how metal GASKETS are constructed

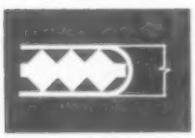
PLAIN ALL-METAL TYPE



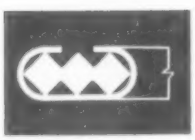
PLAIN SOLID: high mechanical strength, good heat conductivity. Thickness must be uniform and surface smooth. Good for flanges with concentric serrations. Pay close attention to available load in flange bolts. Hardness of material must suit flanges, too.



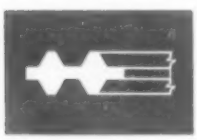
PROFILE: machined with concentric serrations to reduce bolt load needed. Concentric contact lines give many sealing surfaces. By varying profile pitch, gasket loading can match bolt design. Used mostly for high pressures & temperatures in narrow-face closures.



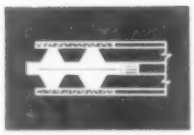
PROFILED-CLAD design has the profile jacketed with a separate metal cover. Jacket is usually a different metal to provide corrosion resistance for the inner gasket. Seating stress is the same for all profile gaskets, jacketed or not. See also next design shown below.



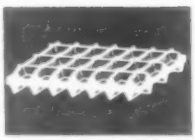
PROFILED-CLAD: a variation in the design above. Here, a heavy, solid metal with concentric V-shaped grooves is partially enclosed by a single metal shell covering one face, both edges, and a portion of the other face. In the preceding design, jacket covers all but the outer edge.



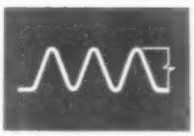
SERRATED type: heavy solid metal machined with spaced concentric rubs. Use where wide gasket with reduced contact area is needed, especially high pressure & temperature with standard raised face flanges (smooth finish). When made of lead or lead alloys, gasket is usually cast.



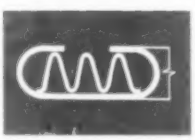
BELLOWSEAL: This design is made up of two metal plates, each provided with spaced concentric ribs on their outer faces, and welded together around the outer periphery. A thin, compressed asbestos sheet is placed over both serrated faces during installation.



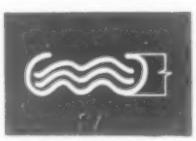
MULTISEAL: Essentially same basic design as that of bellowseal, but having raised cross ribs as well. These gaskets are flexible enough to allow bellows action during sudden temperature changes. Inside pressure forces gasket halves against flange faces.



CORRUGATED gaskets follow simple design shown, are widely used on machined flanges for sealing steam, water, gas, oil, chemicals, under 1000 psi. Corrugations can be increased or decreased as needed. This design is good for narrow-faced joints, and for tongue-and-groove joints

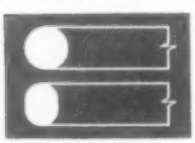


CORRUGATED gasket variation in which the deeply corrugated metal core has been partly enclosed with a metal shell that covers one face, both edges, and a portion of the other face. In another variation, the duplex type, two gaskets are joined at the inner lap.

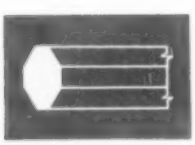


CORRUGATED METAL CORE design is actually three gaskets, with the bottom one lapped over the other two at both edges. This provides a more resilient construction that is useful for high temperatures and for temperature cycling problems.

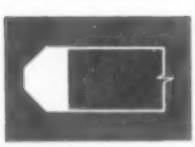
ALL-METAL RING TYPE



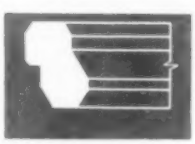
ROUND OR OVAL cross-sectional design for ring-type gaskets are very popular. They are normally made of steel, Monel, chrome-moly, or stainless steels, depending on conditions.



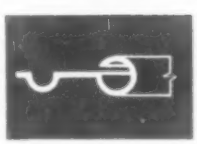
OCTAGONAL cross-sectional design is another variation for ring-type gaskets. Depending on material of construction, these rings are good for pressures up to 15,000 psi and temperatures up to 1600°F.



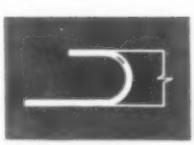
CONVEX cross-sectional design is still another variation from the basic idea in ring-type gaskets. When corrosive operating conditions require it, rings can be plated for additional protection.



TRANSITION RING is a further variation for ring-type joints where there are different ring groove diameters in mating flanges.



RING GASKET PROTECTOR. Instead of plating the ring for corrosion protection, it can be used with a separate protector ring of a suitable material. The design shown has a rolled inner edge.



RING GASKET PROTECTOR variation using a U-shaped inner edge instead of a rolled inner edge. These protective devices also are designed to reduce turbulence.

THE 32 DRAWINGS and descriptions on these pages show most of the many forms of construction for metal gaskets. Three classes are shown—all-metal, all-metal ring-type, and combinations.

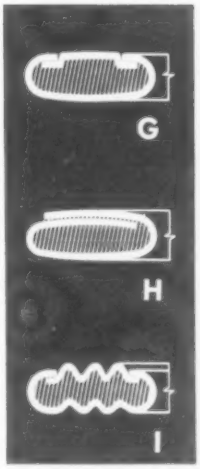
All-metal gasket design is both efficient and economical, particularly on flanges with concentric serrations. However, it is the most difficult to seal. Attention must be paid to flange bolt loading.

All-metal ring types are the tough guys for the tough jobs. They seal under relatively light bolt loads, compensate for minor pipe misalignment, and hold tight under varying conditions.

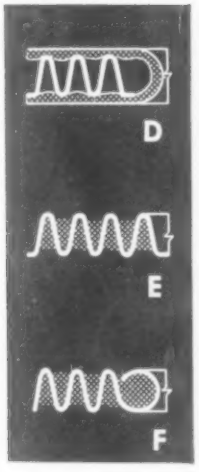
Combinations extend the useful range of metal and non-metallic materials, frequently permitting the use of a soft filler at higher temperatures and pressures, with added corrosion protection.

COMBINATION TYPE

SPIRAL WOUND gaskets are the most familiar and successful example of combination gaskets. They are made of a continuous strip of preformed metal, wound spirally from inside to outside, with a filler cushion between each ply. The cross section of the metal strip is such that compressing the gasket results in a spring loading effect on the metal. Sketch **A** is basic design. **B** is the basic design plus a patented centering guide for accurately positioning on raised-face flanges. **C** shows the basic design provided with a combination compression limiting gauge and centering guide. In these gaskets—beside the primary seal by the metal—the filler compresses under bolt load, filling minute imperfections in the flange face. Spring action permits low seating stress and light bolt loads. If not over-stressed, the gasket has a built-in resilience permitting re-use many times. Filler is usually asbestos, but Teflon is commonly used for corrosive services.

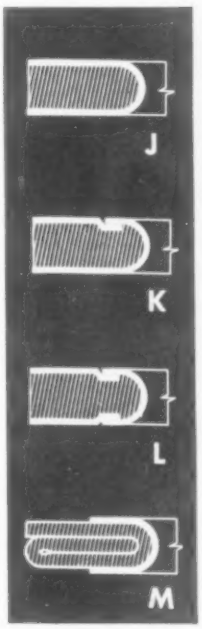


FULLY ENCLOSED type of combination gaskets come in several shapes. They are most often used where the joint is to be broken frequently and the gasket is to be re-used. The cushioning effect of the soft filler permits proper sealing while the full metal jacket stands up under higher pressures and corrosive chemicals. With asbestos as the filler, this construction can be used at temperatures up to 850°F. The sketch at **G** is the double-jacketed design in which the filler is enclosed by a metal shell and a top washer. At **H** the filler is completely enclosed by a single metal shell which overlaps at one face. At **I** is a variation in the design shown at **H** in which the bottom face and the metal washer are corrugated.

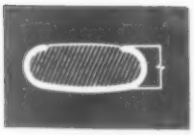


CORRUGATED METAL-ASBESTOS combination gaskets have twisted asbestos cemented into corrugations on both sides of the gasket. When these corrugations are flattened under pressure of bolts, the asbestos is held firmly against the flanges. This thick gasket seals well on poorly aligned work and rough flange faces, with light bolt loads.

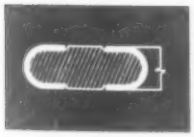
Like the spiral-wound design, these gaskets can also be obtained with various types of centering devices. In addition to centering, however, the outside centering ring prevents lateral expansion of the gasket during compression. Some types act as a compression gage: when flanges touch the ring, gasket is stressed proper amount for good seal. Sketch **D** shows deeply corrugated core covered with woven asbestos cloth. **E** uses twisted and treated asbestos cord cemented into place. **F** is about the same but design includes a reinforcing inner lap.



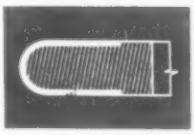
FRENCH type combination gaskets also come in a great variety of designs. Basically, the soft filler is protected by a metal jacket over all but the outer edge, as shown in sketch **J**. This metal jacket can be one-piece as at **J**, two-piece as at **K**, or three-piece as illustrated at **L**. A further variation in the French type is shown at **M**. Here, a thick woven asbestos filler has a one-piece metal jacket covering the inner edge and an equal portion of, but not all, of both contact faces. This design is for glass-lined or other lightly bolted flanges.



PARTLY ENCLOSED or single-jacketed combination gaskets have a soft filler and are partly enclosed—one face, both edges, and a portion of the other face. Used mostly for cylinder heads, and for narrow-faced, small diameter joints, or where easy compressions is a requirement.



EDGE-REINFORCED type of combination gasket uses a soft material reinforced by metal rims on both edges: sides are open. In this and the preceding design, choice of metal will determine corrosion resistance of gasket, and filler will govern temperature limits.



INSIDE-OPEN TYPE is nothing more than a switch in the French type. The soft filler as a single metal jacket over all or part of both faces and the outer edge, with the inner edge open.

two factors in GASKET design and two basic

STARTING from scratch, the designer can adapt flange construction to any desirable gasket design. Selection of a gasket for existing equipment, however, limits gasket design because the joint features are already fixed and cannot be changed as easily as the gasket. The approach the designer uses is different in each case; the principles are the same.

Gasket Yield Stress

A tight seal is obtained by the flow of the gasket material into the imperfections of the contact faces, filling all voids between mating flanges and creating an unbroken barrier to leakage from the joint. Unless this flow takes place, a tight seal is not possible without using sealing pastes or compounds.

The amount of force that must be applied to the contact area of the gasket to cause this flow is called the "yield" force. The yield stress y, is the unit stress, in psi, which is required to cause flow. The term "yield" is misleading and has no relation to the "yield strength" as ordinarily used for materials tested under tension or compression. The yield stress is independent of the internal pressure—it is the minimum stress that must be applied if the gasket is to seal at all, even very low pressures.

Certain gasket materials—such as soft rubber—and a few gasket designs require so little stress to effect a seal that they are considered to be self-yielding. The majority of gasket materials and designs, however, do require a relatively high initial stress if the gasket is to seat properly. Usually, after the application of this high yield stress, the load on the gasket may be reduced considerably without loss in the efficiency of the joint. In practice, this reduction of load is often the result of bolt expansion, creep, and gasket set.

The influence of yield stress upon efficiency of gasket performance is emphasized by the following example from actual test data:

A corrugated iron-jacketed-asbestos gasket was installed in an assembly and loaded with a very low gasket stress of 500 psi. This gasket was not stressed to its yield point and it leaked at a hydrostatic test pressure of less than 10 psi. A duplicate gasket was then placed in the assembly and yielded first at a gasket stress of 1500 psi. This stress was held for a short time and then reduced to 500 psi, same pressure as the initial load in the first test. Hydrostatic pressure was applied and the gasket remained perfectly tight until a pressure of 420 psi was reached. The first gasket, installed with insufficient initial loading would not hold 10 psi; the second gasket, properly seated and reduced to a bolt load of 500 psi, was 4000% more effective.

Gasket Factor

When internal pressure is applied to the gasketed assembly, the hydrostatic end force tends to separate the flanges. This lowers the total load on the gasket, hence decreases the unit stresses induced by initial loading. If the resulting gasket stress falls below a certain value, leakage will occur. The ability of a gasket to maintain a seal at reduced stresses is a function of the resilience of the design and is directly affected by the internal pressure it contains.

The ratio of the residual unit stress on the gasket (in psi) to the internal pressure of the system (in psi) is called the "gasket factor" m, and is constant throughout a wide range of pressure for a given gasket material and construction. Gasket factors for all common materials and constructions are available and are values that have been proved satisfactory in actual service. A gasket factor of 2.0, for example, indicates that the residual stress of the gasket must be a minimum of twice the internal pressure of the system if a seal is to be maintained.

THE PHYSICAL characteristics of the gasket selected—yield stress and the gasket factor—determines the amount of force that will be required for a tight seal.

Step 1—For an existing flange, the designer must first determine the total force available: 1—to yield the gasket, and 2—to maintain a tight seal under service conditions.

The total force, usually supplied by bolts, will depend on the size and number of bolts in the flange, and by the maximum allowable bolt stress. The maximum bolt stress will, in turn, depend on the bolt material and the operating temperature. Mild carbon steel bolts are usually limited to services below 450° F and to a stress of 10,000 psi. Alloy bolts may be stressed somewhat higher, depending on the composition and operating temperature. Generally accepted allowable stress for alloy bolts is 20,000 psi. for purposes of gasket selection.

The total available bolt force can be determined by a simple calculation of the total bolt area times the allowable stress.

Step 2—should be an approximation of the gasket dimensions. For some confined-joint facings, gasket dimensions are limited by the recessed face dimensions. With other facings, considerable leeway is available. A full-face joint may be provided with a full-face gasket to reduce flange distortion. Often, particularly when metallic or semi-metallic gaskets must be used, the bolt force available may not be enough to allow the use of full-face gaskets. In these installations the width of the gaskets must be reduced to form a ring gasket, where available bolt force will give the proper seating stress.

Before metal gaskets came into general use, a wide contact flange was considered necessary to provide surface friction and reinforcement to the soft gasket materials, and thus prevent blow-outs at high pressures. With most metallic gas-

steps

kets, however, the required gasket stresses will be obtained only by using a gasket considerably narrower than the contact faces of the flange.

Knowing the total bolt force available, and having worked out a rough approximation of the gasket dimensions, it is possible to find y and m, the seating stress and the gasket factor at the service pressure. By pairing these findings with a previous selection of materials based on operating conditions, the proper gasket may be selected from a table of gasket factors and yield stresses (Tables 3 and 4).

From the "ASME Code for Unfired Pressure Vessels", the required initial bolt load shall be at least sufficient to seat the gasket so as to assure a tight joint: $W_{m2} = 3.14\ bGy$. And, the required operating bolt load shall be sufficient, under maximum operating conditions, to resist the hydrostatic end force and, in addition, to maintain a compression load on the gasket that experience has shown to be sufficient to assure a tight joint: $W_{m1} = 0.785\ G^2P + (2b \times 3.14\ Gmp)$

Nomenclature for the two formulas is:

W_{m1} = required bolt load for maximum operating conditions, lbs.

W_{m2} = required initial bolt load without internal pressure, lbs.

G = diameter at gasket load reaction.

P = maximum allowable working pressure, psi.

b = effective gasket seating width, inches.

$2b$ = effective gasket pressure width, inches.

m = gasket factor.

y = gasket seating load, psi.

There are several variations and simplifications of these formulas.

Important point is that all published gasket constants are not specifically adaptable to these formulas.. Although the same principles apply, the other constants are accurate, they are tailored to particular formulas.

Table 3—Gasket Materials and Contact Facings

Material	m	y	In Table 4, use: Facing Limits	
Rubber without fabric or a high %age of asbestos fiber:				
Below 75 Shore Durometer	0.50	0	1, 4, 6 only	II
75 or higher Shore Durometer	1.00	200	1, 4, 6 only	II
Asbestos with a suitable binder for operating conditions:				
1/8 in. thick	2.00	1600	1, 4, 6 only	II
1/16 in. thick	2.75	3700	1, 4, 6 only	II
1/32 in. thick	3.50	6500	1, 4, 6 only	II
Rubber with cotton fabric insert	1.25	400	none	II
Rubber with asbestos fabric insertion, with or without wire reinforcement:				
3-ply	2.25	2200	none	II
2-ply	2.50	2900	none	II
1-ply	2.75	3700	none	II
Vegetable fiber	1.75	1100	1, 4, 6	II
Spiral-wound metal, asb. filled:				
carbon steel	2.50	2900	1a only	II
stainless steel	3.00	4500	1a only	II
Serrated steel, asbestos filled	2.75	3700	1a only	II
Corrugated metal, asb. inserted or jacketed asbestos filled:				
Soft aluminum	2.50	2900	1a only	II
Soft copper or brass	2.75	3700	1a only	II
Iron or soft steel	3.00	4500	1a only	II
Monel or 4-6 chrome	3.25	5500	1a only	II
Stainless steels	3.50	6500	1a only	II
Corrugated metal:				
Soft aluminum	2.75	3700	1a only	II
Soft copper or brass	3.00	4500	1a only	II
Iron or soft steel	3.25	5500	1a only	II
Monel or 4-6 chrome	3.50	6500	1a only	II
Stainless steels	3.75	7600	1a only	II
Flat metal jacketed, asb. filled:				
Soft aluminum	3.25	5500	1a, 2* only	II
Soft copper or brass	3.50	6500	1a, 2* only	II
Iron or soft steel	3.75	7600	1a, 2* only	II
Monel	3.50	8000	1a, 2* only	II
4-6 Chrome	3.75	9000	1a, 2* only	II
Stainless steels	3.75	9000	1a, 2* only	II
Grooved iron or soft steel with or without metal jacket:				
Soft aluminum	3.25	5500	1, 2, 3 only	II
Soft copper or brass	3.50	6500	1, 2, 3 only	II
Iron or soft steel	3.75	7600	1, 2, 3 only	II
Monel or 4-6 chrome	4.00	8800	1, 2, 3, only	II
Stainless steels	4.25	10100	1, 2, 3 only	II
Solid flat metal:				
Soft aluminum	4.00	8800	none	I
Soft copper or brass	4.75	13000	none	I
Iron or soft steel	5.50	18000	none	I
Monel or 4-6 chrome	6.00	21800	none	I
Stainless steels	6.50	26000	none	I
Ring joint:				
Iron or soft steel	5.50	18000	8 only	I
Monel or 4-6 chrome	6.00	21800	8 only	I
Stainless steels	6.50	26000	8 only	I

Table 4—Effective Gasket Width b

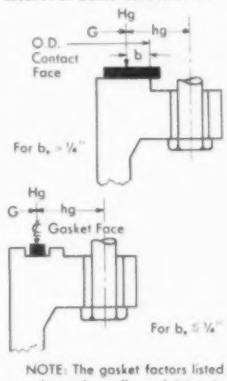
Facing Limits (exaggerated)	Basic Gasket Seating Width b_o	
	Column I	Column II
1a	$\frac{N}{2}$	$\frac{N}{2}$
1b	$\frac{W+T}{2}$; $\left(\frac{W+N}{4}\ \text{max}\right)$	$\frac{W+T}{2}$; $\left(\frac{W+N}{4}\ \text{max}\right)$
2	$\frac{W+N}{4}$	$\frac{W+3N}{8}$
3	$\frac{W}{2}$; $\left(\frac{N}{4}\ \text{min}\right)$	$\frac{W+N}{4}$; $\left(\frac{3N}{8}\ \text{min}\right)$
4 5	$\frac{3N}{8}$	$\frac{7N}{16}$
6 7	$\frac{N}{4}$	$\frac{3N}{8}$
8	$\frac{W}{8}$	

Effective Gasket Seating Width "b"

$b = b_o$, when $b_o \leq 1/4"$

$b = \frac{\sqrt{b_o}}{2}$, when $b_o > 1/4"$

Location of Gasket Load Reaction



NOTE: The gasket factors listed only apply to flanged joints in which the gasket is contained entirely within the inner edges of the bolt holes

Extracted from 1956 edition of Section VIII, Unfired Pressure Vessels, with permission of the publishers, American Society of Mechanical Engineers, 29 West 39th Street, New York 18, N. Y.

special GASKET designs fo

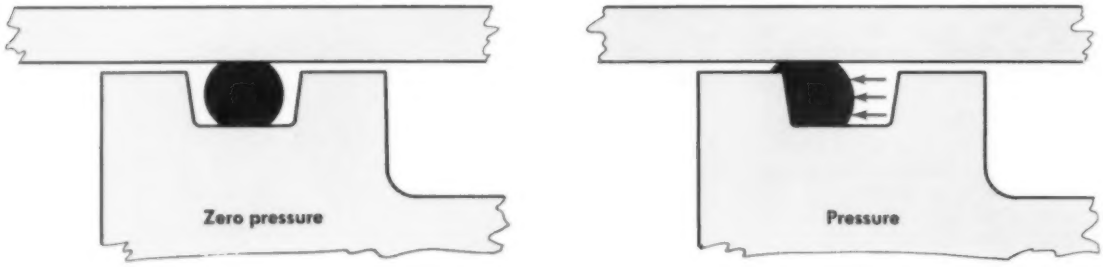
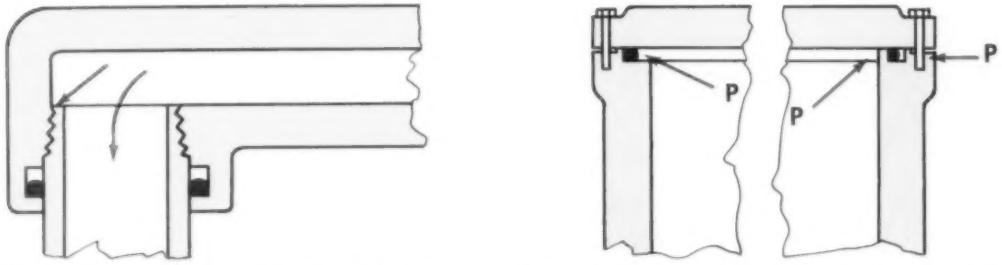


Fig. 9—**In an O-ring,** the higher the pressure, the tighter the seal



Radial Seal — use where parts to be sealed might need adjustment, like turning pipe in O-Ring

Axial Seal — Counterbore (left) for internal pressures only: groove (right) for vacuum and pressure

Fig. 10—**O-rings** can be either radial or axial seals

O-Rings

The development of various synthetic rubbers and resilient plastics that withstand oil and chemical attack have made possible the wide application of the O-ring seal for both static and dynamic seals.

An O-ring assembly consists essentially of a molded doughnut of rubber (or other resilient material) placed in a groove, so constructed that the ring cross-section is slightly deformed when the mating parts are brought into contact. Sealing action is caused by internal pressure that deforms the ring into leakage paths, assuring a tight seal (Fig. 9). The higher the pressure, the tighter the seal.

O-rings can be either radial seals or axial seals (Fig. 10). The radial type seal is best used where adjustment or positioning of metal parts independent of the seal is required. Axial type can be installed in a groove cut into the flange face or in a counterbore.

For an axial type seal, bolts should be stressed only enough to give metal-to-metal contact of mating parts, and to prevent flanges from parting under pressure. Metal-to-metal contact allows the use of O-rings at high pressures with low bolt loads, even when subjected to vibrations and temperature changes.

The Durometer hardness of the ring has a definite relationship to extrusion under pressure. At higher pressures and greater clearances between mating parts, the harder materials should be used to resist extrusion. (Table 5)

A rectangular-section (Fig. 11) groove is usually best for most static seals, although the dove-tail (Fig. 12) has the advantage of holding the ring in position while the joint is being made up. Whatever the groove design, be sure to provide smooth surfaces, chamfered edges, and to remove all burrs or tool marks that might cut or tear the ring.

Table 5—Maximum recommended radial clearances, inches

psi	70 Duro	80 Duro	90 Duro
0-250	0.010	0.010	0.010
250-500	0.008	0.010	0.010
500-1000	0.005	0.008	0.010
1000-1500	0.003	0.005	0.008
1500-2000		0.004	0.005
2000-3000		0.003	0.004
3.000-5000			0.003

Special Metallic Gaskets

Superpressures, say above 3000 psi, demand gaskets of special construction and there are several such designs in common use today. They

s for special services

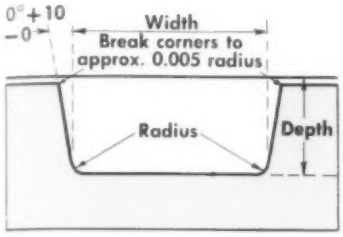


Fig. 11—**Rectangular-section** groove is usually best, but . . .

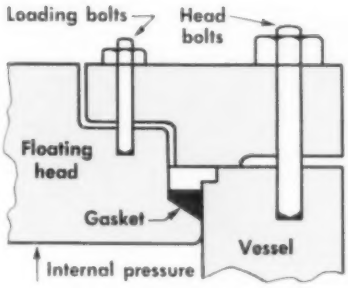


Fig. 13—**Bridgman joint,** a self-energizing type of seal

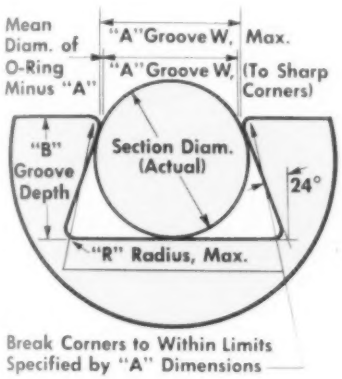

Mean Diam. of O-Ring Minus "A"
"A" Groove W, Max.
"A" Groove W, (To Sharp Corners)
"B" Groove Depth
Section Diam. (Actual)
24°
"R" Radius, Max.
Break Corners to Within Limits Specified by "A" Dimensions

Fig. 12—**Dove-tail** holds ring in position during joining

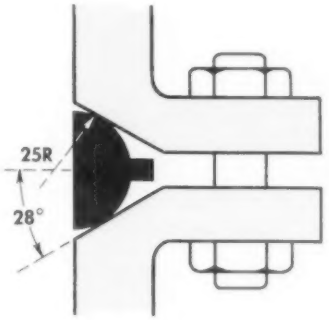


Fig. 14—**Lens-ring joint** is a relatively simple seal

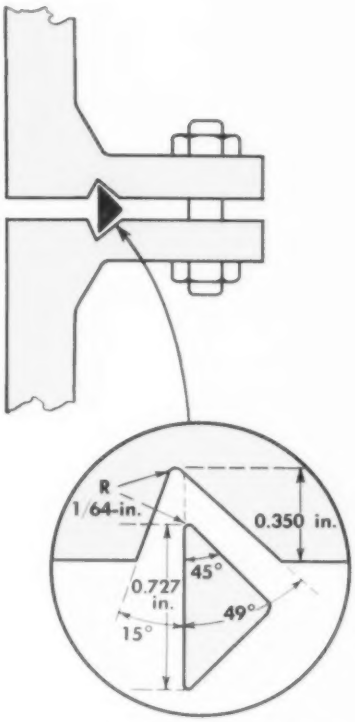


Fig. 15—**Delta joint** has wide adaptability as a seal

are generally considered to be self-sealing. All of the several types are based on the same principle. While pressure governs gasket construction, it influences the choice of gasket material only to the extent of defining the bolting, which is primarily designed to withstand the pressure of the joint. The key requirements of temperature and fluid still determine the choice of gasket material.

Bridgman joint (Fig 13) uses a self-energizing type of seal for large openings in heavy-wall vessels. The gasket is seated initially when the floating head is pulled up by the small loading bolts, then, internal pressure takes over. Any ductile metal can be used for the gasket, depending on the fluid contained and its temperature. This type joint requires careful machining and careful assembly, but is an excellent joint for very high pressure operating conditions.

Lens type joint (Fig. 14) is a simple seal, using basically a lens shaped cross-section seated in a conical flange surface. Initial seating should be a small surface as close to the inner edge of the joint as possible; the small seating area allowing high unit stress with low bolt loads. Gasket can be harder or softer than flanges—some users prefer a gasket with a Brinnell hardness 30-40 numbers lower than flanges, others choose a harder material.

Delta Joint (Fig. 15) has a gasket with a triangular cross-section. It is based on the unsupported-area principle, and sealing action results from deformation of the gasket by internal pressure into flange voids. It is in wide commercial use at pressures up to 30,000 psi and its economical design makes it easily adaptable to any other existing joint. Materials are generally soft iron, aluminum, copper, or stainless steel.

There are other equally successful designs for high pressures, and many variations of construction, but the principles used are basically the same. All high-pressure joints require careful machining, smooth surfaces, clean seating surfaces, and proper application. Careful installation, important to any gasket, is even more imperative at extremely high pressures. A common misconception is that some of the special designs compensate for misalignment of flange faces. In practice, cocked flanges result in uneven bolting pressures and subsequent leakage. Further tightening usually results in full face contact of the gasket and the benefit of the unsupported area effect is lost. There is no substitute for good alignment and proper assembly.

how to get the most out of a GASKET

ONE HANDY GUIDE to the sealing characteristics of a gasket is its compressibility, which varies with material, construction, thickness, and temperature. For good sealing, you have to know what load to place on the gasket. Gaskets must be properly loaded, but if bolting won't take increased load, the answer to the problem may lie in another gasket material.

Gasket Pastes

A paste of graphite and water is often used to prevent the gasket from sticking to flange faces. Oil and graphite is not recommended because the oil in the paste will attack any rubber in the gasket material.

Sealing pastes stir up arguments. Some engineers won't allow them—others won't have a joint made without them. While pastes often help to create the intital seal, their use throws out all the factors entering into careful gasket design. Proper selection of gasket material and construction will, however, make sealing pastes unnecessary; permanent remedies for poor materials and assemblies are impossible with any paste.

Pastes may be classified roughly as 1) soft setting and 2) hard setting. First group includes compounds based on linseed or castor oil, soaps, asphalt, rosin, or shellac. They may be of some aid in sealing a joint with a non-rubber gasket.

The hard-setting types usually expand when set, bringing more pressure on gaskets and helping to build up pitted surfaces, but they have a tendency to crumble as the joint contracts and expands under pressure and temperature, ruining the seal.

Weight of informed opinion says that gasket sealing pastes are not needed if the gasket is right for the job.

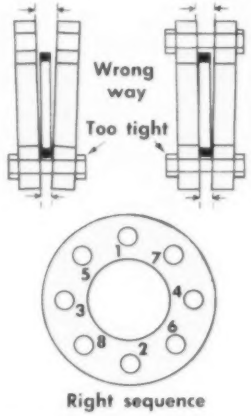


Fig. 16—**Always** tighten bolts properly

Nine Practical Tips For Making the Joint

1—Make flanges as parallel as possible. Cocked flanges can sometimes be made parallel with heat, or by slightly bending the pipe. When truing flanges, make sure that no stresses are left in the joint, particularly in machinery piping. Flanges should be practically mating without bolts.

2—Warped or badly corroded flanges should be replaced or refaced. Flanges with coarse tool marks or scratches that form leakage paths should be refaced or machined with concentric grooves to interrupt the leakage path.

3—Where flanges are badly out of parallel or widely separated and cannot be bolted up, a spacer can be improvised to fill the space. Use a gasket on both sides of the spacer.

4—Remove all burrs, rust, and dirt from flange faces. This is probably the most overlooked step in proper gasket application. Flange scrapers and wire brushes do the best job.

5—Use the thinnest gasket possible that will do the job.

6—Gasket must be wide enough to take bolt loads without crushing, narrow enough to realize the required unit stress.

7—There is one correct way to cut a gasket—with a good cutter. Hammering out a gasket against a flange is a practice of long standing, but produces gaskets that may be lumped. Any variation in gasket thickness reduces its effectiveness.

8—Tighten the bolts properly. (Fig. 16) To pull up one bolt full while the others in a flange are loose will cock the flange out of parallel. Tightening the rest of the bolts will not bring the flanges back into alignment. Proper sequence is to first tighten all bolts hand tight. Then partially tighten two opposite bolts, and move to two others as near 90° from the first two bolts as possible. Each pair of bolts tightened should then be 90° from the preceding pair, until all bolts are tight.

Bolts are good for just so much stress, and further tightening will do one of two things: bolts will stretch, or nuts will upset. But no more pressure will be exerted on the gasket. Hammering on flange bolting to stop a leak is common, but does not stop leakage usually, and the joint has to be broken and remade after cleaning the flange faces and replacing the gasket.

9—Retighten bolts at operating conditions, if possible. Frequent leaks that can be stopped by tightening bolts, however, indicate that creep stresses are too high. A change in bolting material or more resilient gasket may correct the fault.

Bibliography

1) Dunkle and Fetter: "Chemical and Heat Resistance of Gasket Materials", *Chemical Engineering*, Vol. 53, No. 11, November, 1946.

2) Elonka, Steve: "Gaskets", *Power*, Vol. 98, No. 3, pp 105-124, March, 1954.

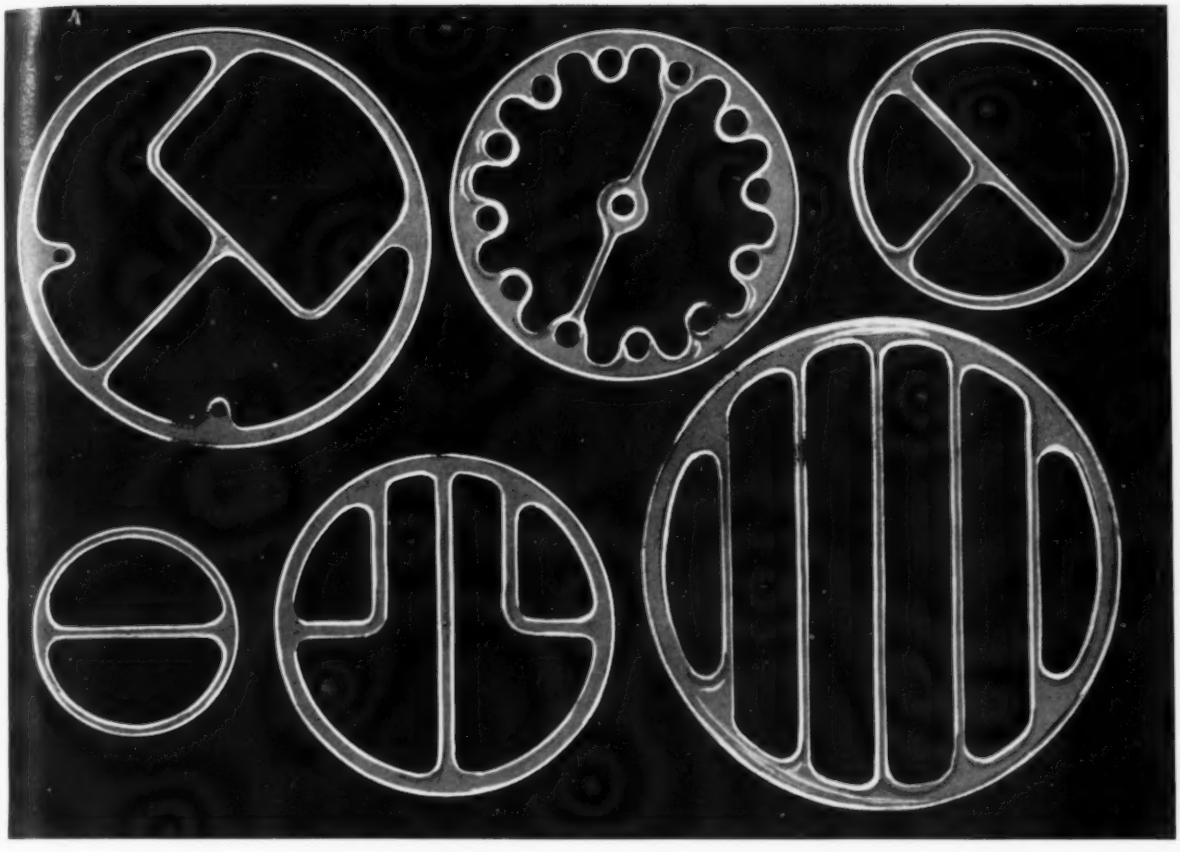
3) Frazier, E. C.: "Design Manual on Nonmetallic Gaskets", *Machine Design*, Vol. 26, No. 11, pp 157-188, November, 1954.

4) Anon.: "The Gasket", The Johns-Manville Corp.

reprints

of this Special Report are available at $0.50 each. Either circle R43 on the Reader's Service Card in this issue or send order to:

Readers' Service Department
PETROLEUM PROCESSING
330 West 42nd Street,
New York 36, New York



SPECIALISTS *in* GASKETS *for* REFINERIES

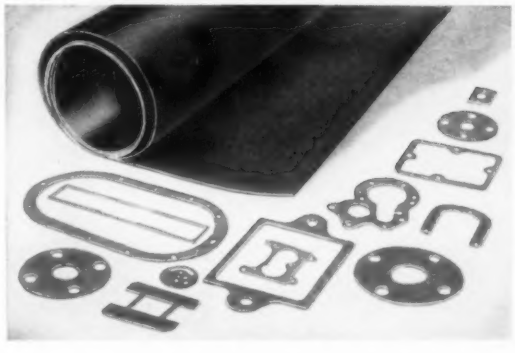
MELRATH makes gaskets for heat exchangers, condensers, and cylinder heads . . . in any shape to fit your equipment . . . in any material (both filler and metal).

Melrath engineers have specialized experience to meet your most critical requirements in high temperature, high pressure applications. Simply write us a description of the service conditions to be met and enclose a blue print of the gasket area involved. Our engineering department will send you a recommendation, complete with samples and quotations in the quantities you need.

Illustrated above are some special shapes in Melrath Style 20 Metal and Asbestos Double Jacketed Gaskets.

Illustrated below are some gaskets from Melrath graphited compressed asbestos sheet (Melrath No. 125). This is a high quality long fiber material resistant to acids, oils, steam and chemicals.

WRITE FOR 64 PAGE CATALOG



"Selling SERVICE Since 1909"

M-700

MELRATH SUPPLY & GASKET COMPANY, INC.

Tioga Street & Aramingo Avenue, Philadelphia 34, Pa. • Phone JEfferson 3-1100

(To obtain more data on advertised products see page 170)

GARLOCK and U

Announce

THE COMPLETE INTEGRATION OF THEIR SALES FORCES

Now, the United States Gasket Company will be known as the United States Gasket Company, Plastics Division of The Garlock Packing Company.

In August 1955 Garlock acquired the United States Gasket Company. Subsequently, the production facilities of both companies were integrated. Now, it is clear that the customers of both companies will be better served through an integrated sales force.

Better Service for Customers

Both U.S.G. and Garlock customers will now enjoy the finest, most complete service available in the fields of fluorocarbons (Teflon* and Kel-F**), nylon and other plastics as well as mechanical packings and seals of all types. Specialists in specific materials and applications will always be available for consultation on your problems.

Saves You Time

This integration of sales forces will also simplify your purchasing problem . . . you can standardize on one reliable source of supply and have more time to devote to other important problems.

Unbiased Recommendations

With the addition of U.S.G. plastic products to the famous "Garlock 2,000" family of packings, gaskets, and seals, your local representative is able to supply the right seal for every conceivable need. Call him at the office nearest you.

30 Sales Offices

U.S.G. plastics specialists join the 125 Garlock salesmen at 30 sales offices and warehouses where large stocks of plastic products are stored. This means faster deliveries from local stocks, as well as expert plastics and sealing assistance as close as your telephone.

*DuPont Trademark
**M.W. Kellogg Trademark

Main Factory Buildings of The Garlock Packing Company, Palmyra, New York. Other factories in San Francisco and Canada.

One of the two Camden, N.J. plants of the United States Gasket Company, Plastics Division of The Garlock Packing Company

 (To obtain more data on advertised products see page 170)

United States Gasket

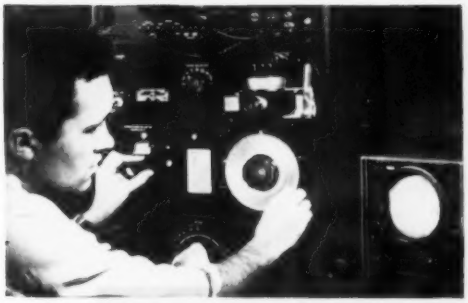
UNITED STATES DISTRICT OFFICES AND WAREHOUSES

Baltimore 18, Md., *2828 Lock Raven Rd.*
Birmingham 1, Ala., . . . *519 S. 19th St.*
Boston 10, Mass., ... *80 Broad St.*
Buffalo 2, N.Y., ... *38 Pearl St.*
Chicago 6, Ill., ... *600 W. Jackson Blvd.*
Cincinnati 16, Ohio, ... *8329 Vine St.*
Cleveland 13, Ohio, . . *1276 W. Third St.*
Denver 2, Colo., ... *1863 Wazee St.*
Detroit 11, Mich., . . *2781 E. Grand Blvd.*
Houston 3, Texas, *2105 McKinney Ave.*
Los Angeles 21, Calif., . . *2303 E. 8th St.*
New Orleans 25, La., *3525 Lowerline St.*
New York 6, N.Y., ... *114 Liberty St.*
Palmyra, N.Y., ... *Maple Ave.*
Philadelphia 2, Pa., ... *20 S. 15th St.*
Pittsburgh 22, Pa., ... *933 Penn Ave.*
Portland 9, Ore., . . *1036 N.W. 18th Ave.*
Salt Lake City 1, Utah, *322 Dooly Bldg.*
San Francisco 7, Calif., *750 — 18th St.*
St. Louis 8, Mo., *3635 Forest Park Blvd.*
Seattle 4, Wash., ... *814 Lane St.*
Spokane 4, Wash., . . *W. 610 Second Ave.*
Tulsa 20, Okla., *816 E. 6th St.*

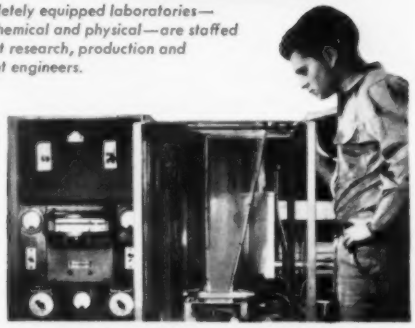
CANADIAN OFFICES AND WAREHOUSES

Edmonton, Alb., ... *8407 — 103rd St.*
Hamilton, Ont., ... *200 Queen St.*
Montreal 9, Que., *5214 De La Savane St.*
Toronto 2, Ont., ... *750 Bay St.*
Vancouver 5, B.C., *1925 W. Georgia St.*
Winnipeg 3, Man., ... *1436 Erin St.*

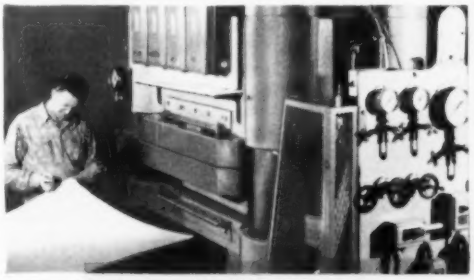
SPECIALIZED PLASTICS PRODUCTS FACILITIES AT U.S.G.



Three completely equipped laboratories—electrical, chemical and physical—are staffed by top-flight research, production and development engineers.



One of many extruders for TEFLON, KEL-F and nylon rods, tubes and special shapes.

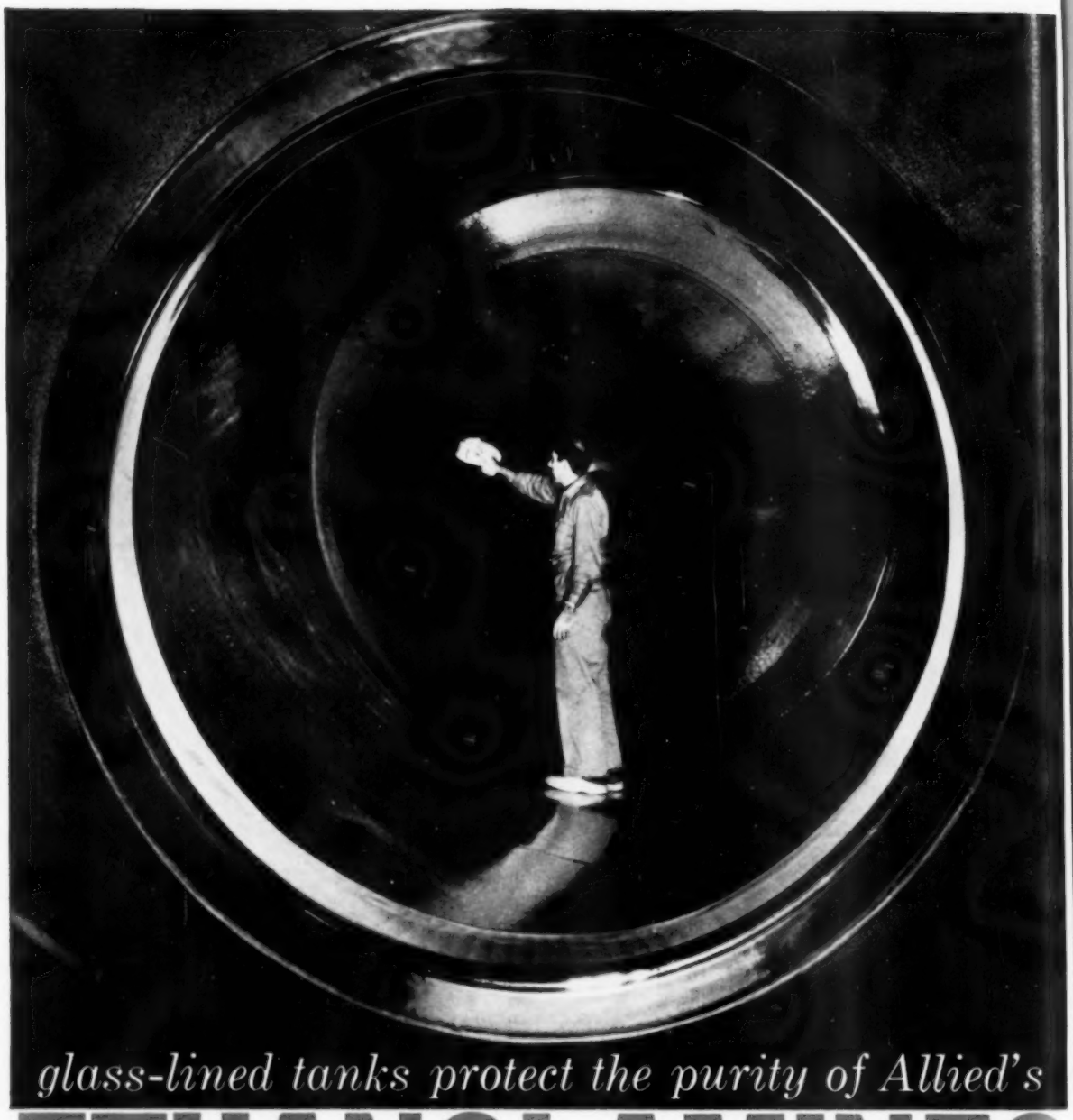


Giant presses cold mold TEFLON sheets up to 48" x 48" in size, ready for sintering.

High product, low-cost injection molding of thermoplastic parts to manufacturers specifications.

GARLOCK

Packings, Gaskets, Oil Seals, Mechanical Seals, Rubber Expansion Joints, Fluorocarbon Products



glass-lined tanks protect the purity of Allied's

ETHANOLAMINES

You are looking down the manhole of a 16,000-gallon, glass-lined Pfaudler storage tank about to be filled with an ethanolamine from Allied.
Why glass-lined? To protect the excellent color and high purity of the chemical as it comes from Allied's stainless steel processing equipment.

Allied makes ethanolamines which more than meet the highest industry specifications, and then makes certain they will remain uncontaminated through storage and shipment to your own facilities. Phone or write for samples, quotations, literature and technical service – all without obligation.

Dept. EA 4-20-1

Allied Chemical — NITROGEN DIVISION

40 Rector Street, New York 6, N. Y.

Ethanolamines • Ethylene Oxide • Ethylene Glycols • Urea • Formaldehyde • U. F. Concentrate—85 • Anhydrous Ammonia • Ammonia Liquor • Ammonium Sulfate • Sodium Nitrate • Methanol • Nitrogen Solutions • Nitrogen Tetroxide • Fertilizers & Feed Supplements

Your Guide to . . . Petroleum Processing Departments

Keep Your Data File Up-to-Date

"Clip-n-File" process data

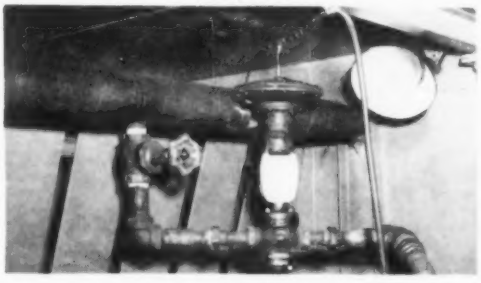
Nitric Acid

How nitric acid is made by the Chemico process is the subject of this month's Process Data Sheet. **p. 119**

"Clip-n-File" engineering data

Combustile Vapors

Telling what they are, how they contribute to combustion, and including a valuable table of explosive ranges of different vapors **p. 139**



Foot valve protects test operator

How do you prevent a runaway steam turbine when the governor fails? Check this month's Plant Practices to see how Esso Standard Oil found an ingenious solution to this problem. **p. 123**

How Frenchy handled the crawfish

The story is told in this month's "Bull Pen." The fresh water reservoir had just been finished when the trouble started. Marty Simms was mighty glad he got off the hook. **p. 129**

Letter from Detroit

Here's a special this issue: an exclusive report from the just-held SAE meeting in the motor capital. Some highlights: nuclear propulsion and gas turbines for autos played down, improvements in piston engines played up. See "Meetings" **p. 133**

Automatic detective eyes suspects

What we mean is, a new drum recorder provides a simple, durable record of the operation of any piece of equipment. To read about this unit, and the pick of other new products, turn to "What's New" **p. 173**

INDEX TO DEPARTMENTS

Advertisers' Index....170
Bull Pen....129
Editorials....204
Engineering "Clip-n-File" Data....139
Equipment—What's New!....173
Information Offered....168
Meetings for Oil Men....133
New Words in Your Reading....131
Operating Trends....165
Patents....153
Personals....143
Plant Practices....123
Process "Clip-n-File Data....119
Readers' Service Card....171
Statistics—Operating Trends....165
Suppliers' News....147
What's New!....173

Single Crane Valve Gives Double Valve Protection

Look, man!—one valve and no blind gives positive isolation of any line

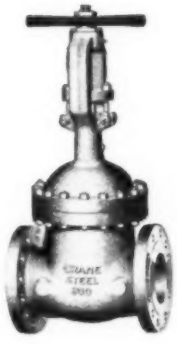
Phillips Petroleum Co. engineers wanted safe, efficient valve operation during regeneration cycling in the new unit at their Borger, Texas, refinery. They installed Crane steel gates modified with the Crane-designed flexible disc.

These valves safely isolate the regenerating gas from the gasoline vapors while desulphurization reactor chambers are regenerated. Gasoline vapors are processed at 90 psi and 700 deg. F. Steam and air for regeneration are at 15 psi and 900 deg. F.

Regardless of pressure differential, the Crane flexible disc provides a positive, leak-free seat at both upstream and downstream sides. No need of putting in blinds; no danger of forgetting them in the line.

Equipped with bonnet vent lines to atmosphere, the valves provide for drainage of fluids trapped in body. During on-stream cycle they prevent gasoline vapors from entering the stacks.

Available in 2 to 12-inch sizes, in up to 1500 psi classes, Crane steel gates modified with flexible disc eliminate the need for double valving in your refinery, dehydrator, pipeline and other operations. Write to address below for full information.



CRANE VALVES & FITTINGS

PIPE • PLUMBING • KITCHENS • HEATING • AIR CONDITIONING

Since 1855—Crane Co., General Offices: Chicago 5, Ill. Branches and Wholesalers Serving All Areas

Process—Synthesis under pressure of nitric acid by the catalytic oxidation of ammonia with air and absorption in water, with recovery of power from the tail gases.

Process chemistry—The basis for the nitric acid process is the oxidation of ammonia to form nitric oxide as follows:

$$4NH_3 + 5O_2 \rightarrow 4NO + 6H_2O$$

This reaction is carried out at elevated temperature and pressure across a platinum-rhodium catalyst. Several side reactions may occur, of which the most important one is:

$$4NH_3 + 3O_2 \rightarrow 2N_2 + 6H_2O$$

About 96% of ammonia is oxidized in accordance with the first reaction. The side reaction is controlled by the operating temperature, pressure, velocity, ammonia concentration, cleanliness and quantity of catalyst. Upon cooling the product, the nitric oxide is further oxidized to NO as follows:

$$2NO + O_2 \rightarrow 2NO_2$$

This reaction is relatively slow, so that reaction volume is a major criterion in processing. The NO_2 is then absorbed in water according to the following reaction:

$$3NO_2 + H_2O \rightleftarrows 2HNO_3 + NO$$

The nitric oxide formed by this reaction is reoxidized to NO_2 which in turn reacts with more water to form nitric acid. Several side reactions producing HNO_2 may occur simultaneously. All the forward reactions shown are highly exothermic.

Process flow—In the Chemico process, atmospheric air is compressed to about 8 atmospheres. Intercooling of the compressor is controlled to produce compressed air at the desired temperature required for most efficient operation (about 450°F).

About 80% of the hot compressed air is filtered and mixed with superheated, filtered ammonia vapor. This mixture passes through the converter and over a platinum-rhodium gauze. The hot gases leave the gauze at about 1650°F and pass in succession through a tail gas heater, waste heat boiler, catalyst recovery filter, tail gas preheater, and water cooled condenser, thereby being cooled to about 140°F, before flowing to the absorption tower. Nitric oxide is continually converted to the dioxide, which is absorbed in makeup water and weak acid in the tower, and the 60% nitric acid leaves at the bottom.

The remaining 20% of hot compressed air contacts the acid before discharge, removing nitrous acid, and then mixes with the process gas being absorbed.

The tail gas, about 96% nitrogen, is reheated to about 900°F by exchange with the process gas in the two tail gas heaters previously mentioned. If natural gas, hydrogen or the equivalent is available, the tail gas can then be further heated to 1250°F in a Chemico catalytic combustion unit, destroying nitric oxide fumes, and then expanded through a gas turbine to provide power required for the initial air compression. Additional steam is produced from the gas leaving the turbine in a waste heat boiler.

Where steam is particularly valuable, the tail gas may be heated to 1250°F in the catalytic combustion unit to destroy nitric oxide fumes, cooled in a waste heat boiler and then expanded through the turbine at a lower temperature.

If fuel gas is not available for the combustor, the tail gas from the heater at 900°F goes directly to a gas expander driving the air compressor.

Catalyst—The catalyst used to oxidize ammonia in the Chemico nitric acid process consists of a number of finely woven, 90% platinum, 10% rhodium gauzes. There is some loss of catalyst during operation, about half the metal being recovered in the filter. Fresh catalyst must be inserted in the converter periodically to maintain high oxidation efficiencies.

Catalyst efficiency is lowered rapidly by impurities particularly hydrocarbons, in the air or ammonia, but gauzes are readily regenerated by proper pickling.

Operating conditions and variables—The standard Chemico nitric acid plant is designed to operate at about 8 atmospheres in the absorption tower. Pressure drops through the various pieces of equipment are kept to a minimum so as to yield maximum acid recovery, and to recover the greatest amount of power from the tail gas.

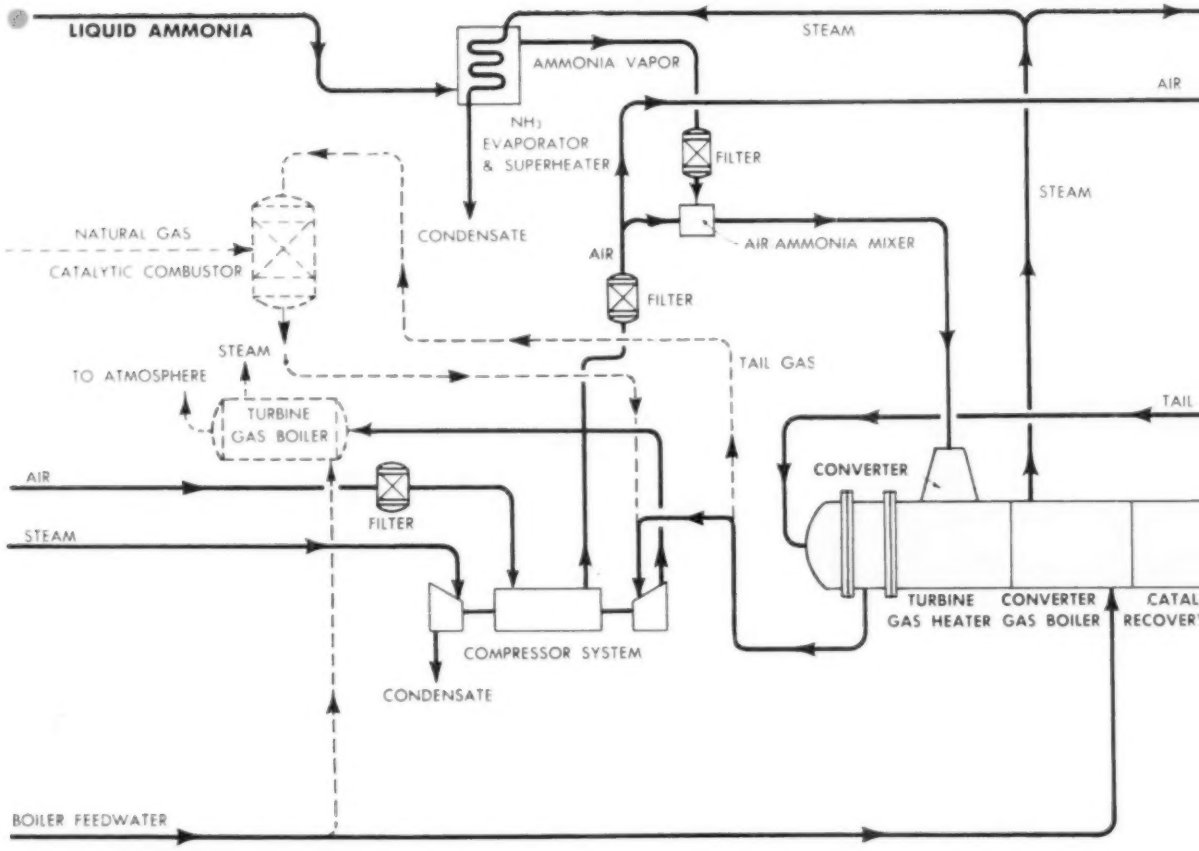
Ammonia oxidation efficiency increases with increasing gauze temperature, as does catalyst loss. The optimum operating condition is in the range of 1650-1700°F. With air preheated to about 450°F, about 10.5% ammonia in the feed to the converter will yield this temperature.

Nitric oxide oxidation and acid formation are favored by lower operating temperatures and higher pressures. Temperatures in the absorption tower vary from about 120°F at the bottom to 100°F at the top. Of the nitrogen fed to the tower, about 99% is recovered as nitric acid products. The acid is produced in concentrations up to about 62% by weight, and is varied by adjusting makeup water feed to the top of the tower.

Power recovery from the tail gas increases with the temperature and pressure at the expander. With fuel gas available, temperatures up to 1250°F have been used and nitric oxide fumes in the tail gas destroyed. Without fuel gas, the maximum recovery temperature is about 950°F.

Equipment—The Chemico nitric acid plant consists of three basic sets of equipment—air compression system, "exchanger train," and absorption tower. The centrifugal air compressors are direct-connected to the gas expander and either a steam turbine or electric motor, which provides the makeup power required.

The equipment in the exchanger train, which cools the process gases, is designed to bolt directly together and can be shipped as a single



unit. This eliminates much interconnecting piping and reduces plot plan requirements, erection time, and maintenance.

The heat transfer to the two tail gas heaters and the waste heat boiler is adjusted for maximum thermodynamic efficiencies, depending upon the steam pressure and expander temperature desired.

The nitric acid absorption tower is designed for the operations of oxidation, absorption, cooling and bleaching of the product. The unit is made entirely of stainless steel with integral cooling coils on bubble-cap trays. If desired, access can be provided to all trays, and coils can be made replaceable.

Operating requirements—The table shows typical operating requirements for nitric acid plants per short ton of equivalent 100% nitric acid produced. Requirements for a specific plant will vary somewhat depending particularly upon the size of the installation.

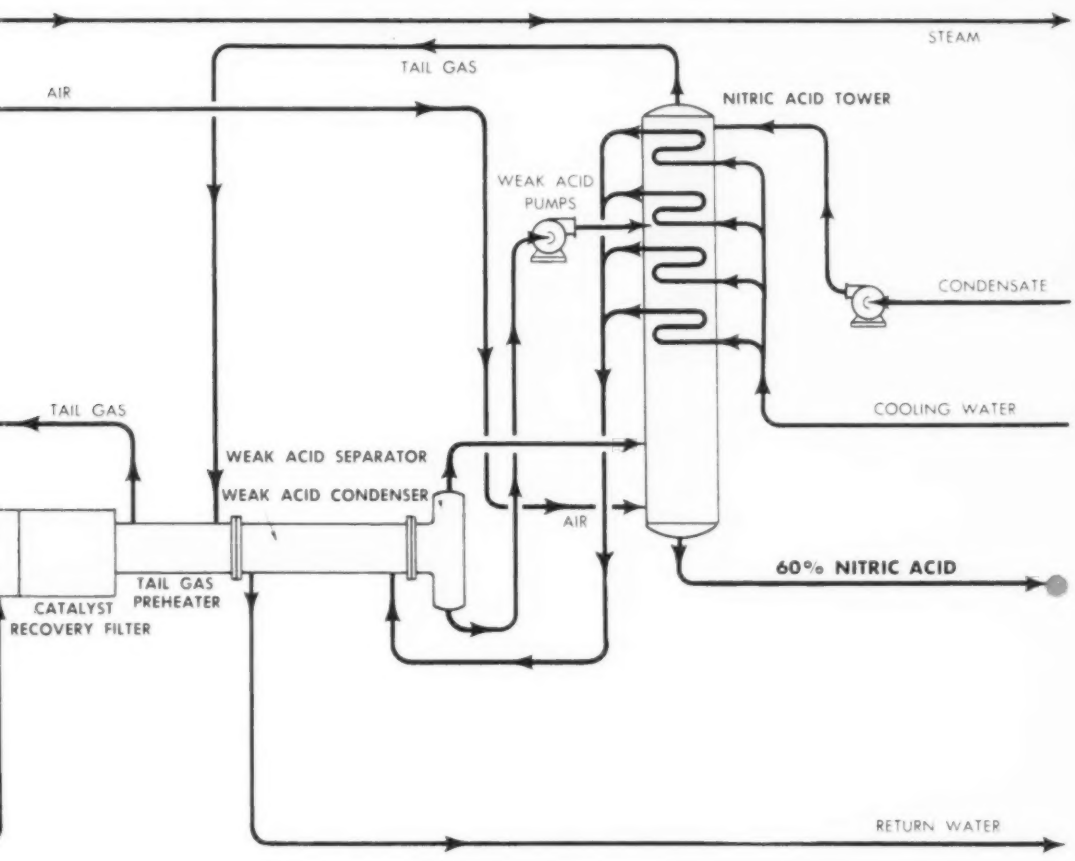
Installations—Chemico nitric acid plants have been erected all over the world during the past 35

Typical operating requirements for Chemico Nitric Acid plant

(basis: short ton of 100% HNO_3 produced)

Tail gas temperature, °F	900	900	1,250
Makeup power, type of drive	electric	steam turbine	steam turbine
Liquid NH_3, short tons	0.290	0.290	0.290
Platinum-Rhodium catalyst, Troy oz. (net)	0.005	0.005	0.005
Cooling water, gal	30,000	50,000	42,000
Electricity, kwh	240	5	5
Steam, short tons	(0.75*)	0.90	none
Boiler feedwater, short tons	0.83	0.83	1.06
Condensate, short tons	0.32	(1.3*)	(0.65*)
Fuel gas, MMBtu	none	none	0.96

*Exported from plant.



Chemico Nitric Acid Process

... with tail gas power recovery

UNFOLD **FOR START OF PROCESS DESCRIPTION**

years in capacities from 10 short t/d to 250 short t/d/stream, with a total erected capacity exceeding 3500 short t/d.

Nitric acid plants were built in the U.S. and Canada for explosives manufacture early in World War II, with a total capacity exceeding 1310 short t/d. These plants are now owned and operated by Monsanto Chemical Co. in Arkansas, Spencer Chemical Co. in Kansas, North American Cyanamid Co. in Ontario, and Consolidated Mining and Smelting Co. in Alberta. Several plants were built in the United Kingdom and India.

Plants recently erected or now under construction include Allied Chemical & Dye Corp., Va., 250 short t/d; American Cyanamid Co., W. Va., 75 short t/d; Central Trust of China, Taiwan, 160 short t/d; Escambia Bay Chemical Corp., Fla., 220 short t/d; Monsanto Chemical Co., La., 450 short t/d; and S.E.E.I.C., Egypt, 450 short t/d.

Licensor—The licensor for the process described in the accompanying article is Chemical Construction Corp., 525 W. 43rd Street, New York 36, N. Y.

References—More information on the above and other nitric acid processes may be found in:

(1) Strelzoff, S., "Today's Commercial HNO_3 Processes: A Critical Comparison," *Chemical Engineering*, May, 1956, pp. 170-4.

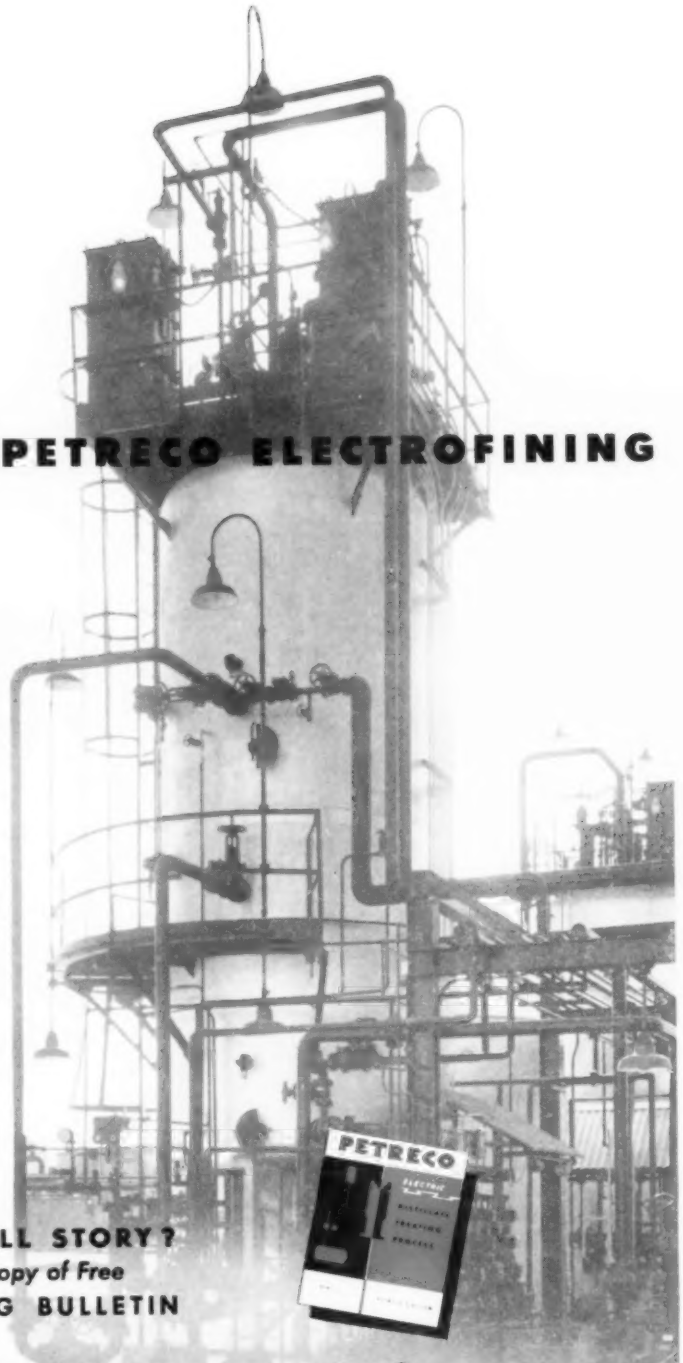
if your PROBLEM is . . .

CAUSTIC WASHING . . .
ACID TREATING . . .
WATER WASHING . . .
or, otherwise contacting a distillate stream with chemicals in aqueous solution

your best ANSWER is . . . PETRECO ELECTROFINING

BECAUSE . . .

1. It offers continuous, once-through operation.
2. Saves up to 70% on installation.
3. Requires smaller area, less piping, fewer pumps.
4. Is precise and automatic, with distillate contacted with correct amount of treating agent, of the proper intensity, for the right length of time.
5. Insures a better product by removing reaction products of treatment which normally create haze problems in conventional treating.



WANT THE FULL STORY?
Write for your copy of Free
ELECTROFINING BULLETIN

PETRECO®

A DIVISION OF PETROLITE CORPORATION

SPECIALIZED ELECTRIC PETROLEUM TREATING

DESALTING • DEHYDRATING • CAUSTIC WASHING • ACID CONTACTING • DOCTOR TREATING
SWEETENING • NAPHTHENIC ACID REMOVAL • SEDIMENT REMOVAL

3202 S. Wayside Drive, Houston 1, Texas • 1390 East Burnett St., Long Beach 7, California

DT-57-3

here's how Dowell chemical cleaning saved $71,000 and helped protect a plant profit!

A few months before their peak season, the operators of this plant decided their main water line might not supply the water necessary to meet peak demands. The line was cast-iron, 16-inches in diameter and over 7,000 feet long. Its original flow efficiency or "C" factor had been 105; scale build-up had reduced this to 72. To lay an auxiliary line would cost at least $85,000.

Dowell contracted to clean the pipe chemically for a little less than $14,000, and to restore a minimum of 50 per cent of the line's lost capacity.

This Dowell did, and more—increasing the "C" factor to 92! Enough water was immediately available for capacity operation. This saved the plant $71,000 and helped protect the company's annual profit.

The operating credit realized by this food processing plant, as a result of Dowell service, is similar to those realized by other Dowell customers—in the steel, paper, chemical, oil refining, power and allied industries.

Dowell engineers are experts in the use of solvents to remove scale and sludge—deposits that cut the throughput of product, process and steam generating systems. Dowell does the job, furnishing all chemicals, trained personnel, pumping and control equipment.

For specific information on how chemical cleaning can help you to greater profits, call the Dowell office nearest you. Or write Dowell Incorporated, Tulsa 1, Oklahoma.

Have Dowell clean it chemically DOWELL

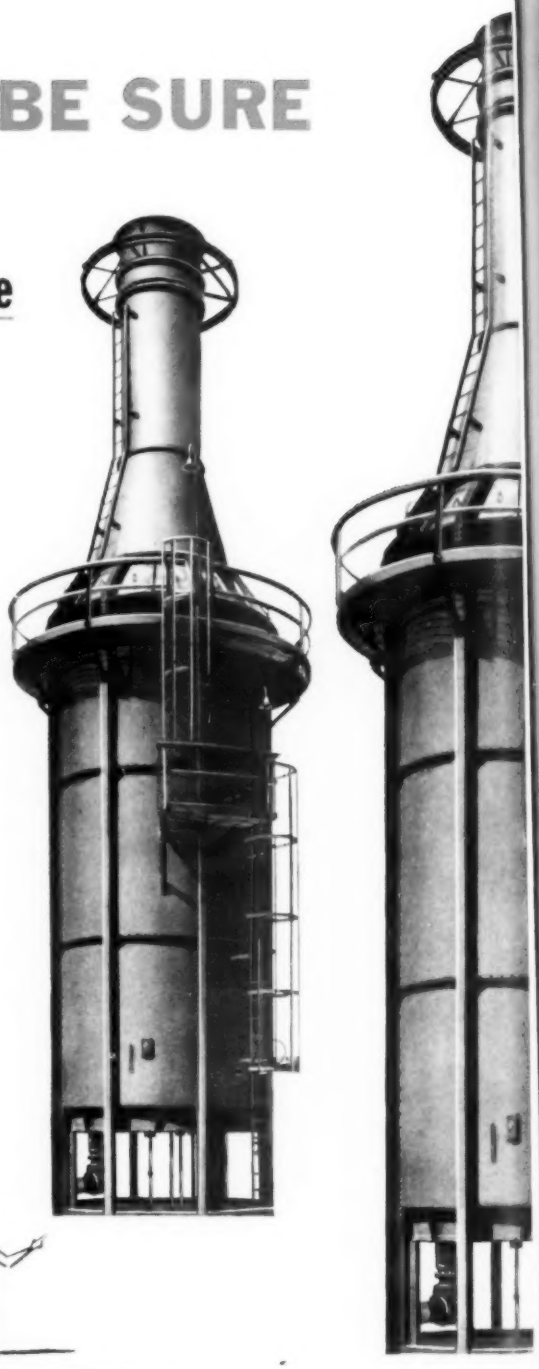
A SERVICE SUBSIDIARY OF THE DOW CHEMICAL COMPANY

YOU, too, CAN BE SURE

petrochem-isoflow furnaces

are most economically desirable

by any comparison



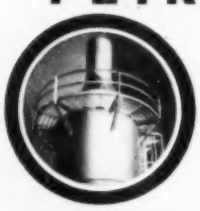
Whenever *all* the specifications and *all* the operating requirements are applied to direct-fired furnace design, you can be sure PETROCHEM-ISOFLOW FURNACES will be found most economically desirable, by any comparison.

In making comparisons it is essential to take these factors into consideration:

1—Average radiant transfer rate.
2—Maximum deviation from average radiant transfer rate.
3—Average and maximum transfer rate in convection section.
4—Maximum tube wall temperature, radiant or convection.
5—Maximum efficiency with specified excess air.
6—Controlled thermal recirculation of flue gases to provide even heat distribution throughout full length of each tube and equalized heat distribution around each tube.
7—Overload and corresponding transfer load.
8—Design to provide: structural column supports—Ladders—Platforms—Tube Removal facilities, etc.
9—Degree of assembly; of the furnace structure and of the heating surface.

When you specify PETROCHEM-ISOFLOW FURNACES ... you'll be in good company. More than 1500 are now in service, performing to the complete satisfaction of their operators and usually well beyond their rated capacities.

PETROCHEM-ISOFLOW FURNACES



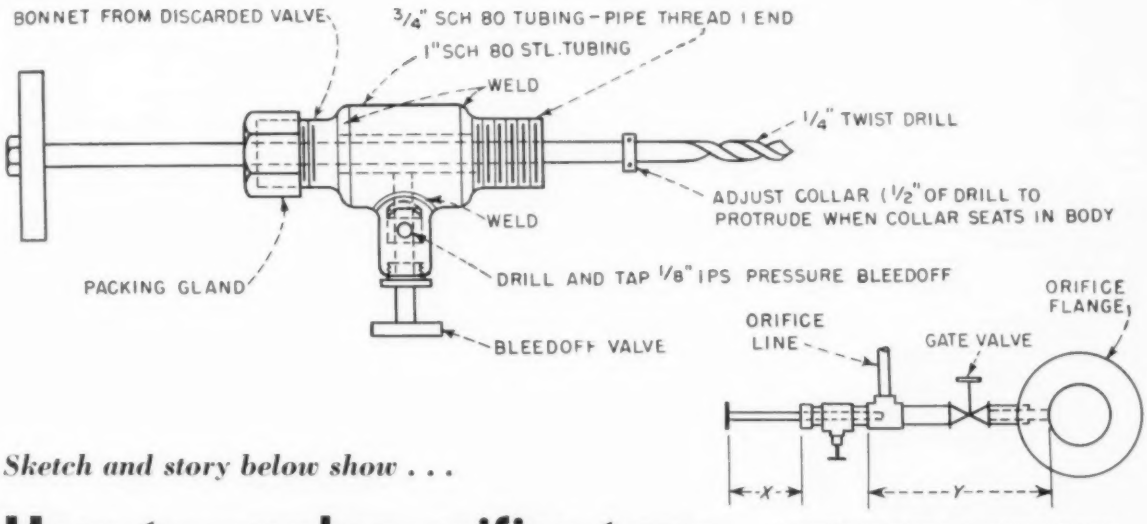
UNLIMITED IN SIZE ... CAPACITY ... DUTY

PETRO-CHEM DEVELOPMENT CO., INC. • 122 EAST 42nd St., New York 17, N. Y.

REPRESENTATIVES:

Rawson & Co., *Houston* • Wm. H. Mason Co., *Tulsa* • Lester Oberholtz, *Los Angeles* • Faville-Levally, *Chicago* • D. D. Foster, *Pittsburgh* • Turbex, *Philadelphia* • Flagg, Brackett & Durgin, *Boston* • G. M. Wallace & Co., *Denver & Salt Lake City*

International Licensees and Representatives: SETEA—S.A. Comercial, Industrial, y de Estudios Tecnicos, Buenos Aires, Argentine • Industrial Proveedora, Caracas, Venezuela • Societe Anonyme Huertey, Paris, France • Societe Anonyme Belge, Liege, Belgium • Huertey Italiana S.P.A., Milan, Italy • Birwelco Ltd., Birmingham, England



Sketch and story below show . . .

How to unplug orifice taps

By James W. Ross*

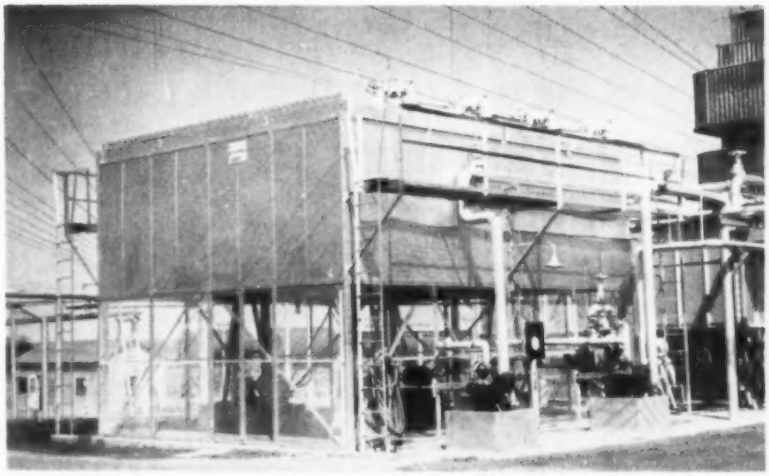
PLUGGED orifice taps, or plugged orifice valves, can cause plenty of trouble in operating any refinery unit. But here is one way that plugged orifice taps and valves can be safely opened on hot oil, steam or gas lines. The device, which not only unplugs valves but also permits checking them for tightness, can be made from scrap parts by almost any welder.

The sketch above shows the method of assembling this unplugger. A bonnet from a ½-in. discarded valve is welded to one end of a 1½-in. long piece of 1-in. diameter pipe. To the other end of this short piece of pipe is welded a 1¼-in. length of threaded ¾-in. pipe. At the center of the 1-in. pipe a ½-in. hole is drilled, over which a ⅛-in. steel valve is welded. The stem of the large valve is replaced with a long twist drill having an adjustable collar, with the drill extending through the entire assembly.

In use, the unplugging device is mounted on the straight run of pipe from the orifice and orifice valve. The gate valve sealing off the orifice is opened (if not plugged open), and the twist drill is forced through. If desired, the small bleed-off valve may be opened to relieve pressure while drilling out the plug.

After the twist drill is withdrawn back into the barrel of the device, the main gate orifice valve can be tested for tightness. When it is closed any leakage through it can be safely detected by opening the side bleed-off valve.

*Mr. James W. Ross is a No. 1 instrument man for Gulf Refining Co. at Cincinnati, Ohio.



Dual drive gives flexible cooling

USING both electric and steam drives for the fan air coolers at Dorchester Corp.'s Cargray natural gasoline plant near White Deer, Texas, gives operating versatility as well as protection in case of power failure.

Four fans are used: two with electric drives and two with steam drives. Normal operation is with the two electric drives running at constant speed and the two steam drives at variable speed. If the electricity goes off, the two steam turbines go up to full speed. This is sufficient to carry the cooling

"It's the most practical of all!"

SAYS
Jim Gardner
President
The Cincinnati Tool Co.

• • •

ABOUT THE IMPROVED

SPEARHEAD EXTENSION GASKET CUTTER

"In the past 50 years we've tested virtually every gasket cutter on the market, but without question, this new extension model is the most practical yet! It has the simplest, most practical design of any gasket cutter I've ever seen . . . the aluminum body is lightweight and has smooth rounded edges that makes it convenient to handle. Its wide range of uses amazes me. I was sold the first time I tried one!"

• • •

You'll be sold too, after you try one and prove to yourself how efficient this new Spearhead Extension Gasket Cutter really is. This hand tool will cut from 1" to 13", and with easily attached extension arms you can cut round gaskets up to 36", 60", 72" . . . any size . . . for heat exchangers, tool equipment, heaters, furnaces, pumps, piping, etc. Pliable sheet materials like .005" vegetable fibre, 1/16" Teflon, 1/8" compressed asbestos, 1/2" cork and 1" rubber can be readily cut.

• • •

This tool belongs in every man's tool kit. Now available through over 2,000 distributors the world over.

• • •

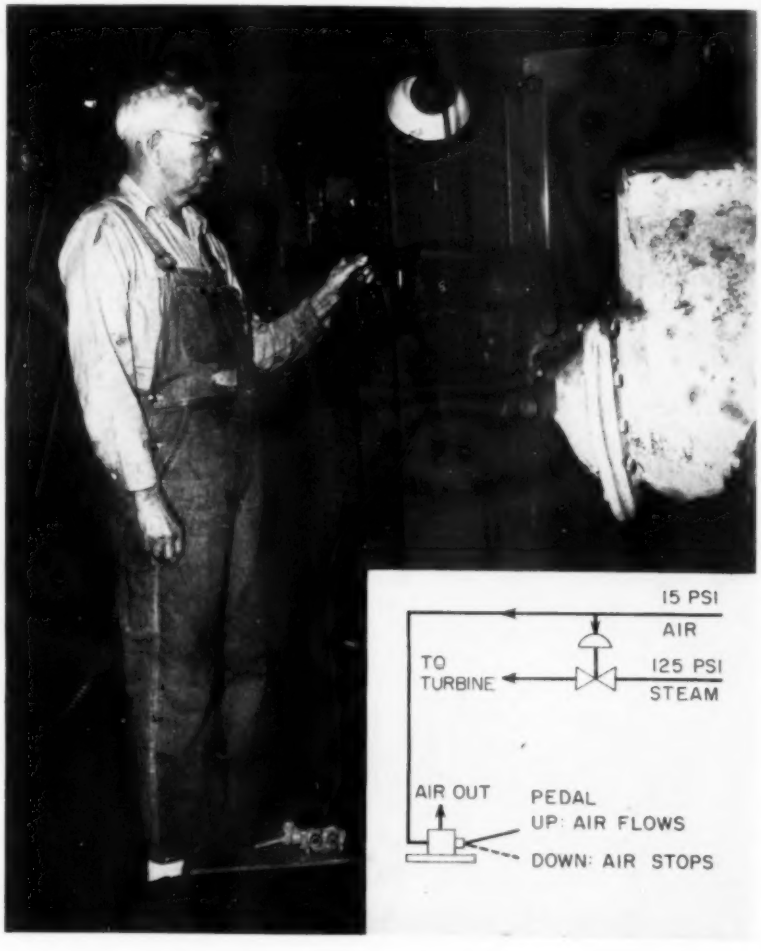
Contact your local supplier for complete information and prices, or write to . . .

ZIMMERMAN PACKING

CINCINNATI 12, OHIO

load until electric service can be re-established.

The cooling section itself is used to cool water for use in the dephlegmator, which knocks out liquid, absorber oil, and steam from the primary still overhead gas. A temperature control on the dephlegmator controls the steam supply to the steam drives. This permits operation at constant water temperature by permitting the variable steam load to control the extent of the cooling. The electric motors carry the base load for cooling unless a power failure occurs, which raises steam turbine speed, as mentioned above.



Foot valve averts turbine runaway

SERIOUS trouble can develop when running a steam test on a turbine, particularly if the governor fails. It's a mighty rugged job to shut off the valve on the test-steam line fast enough to stop a runaway turbine wheel.

Maintenance men at Esso Standard Oil Co., Louisiana Div., Baton Rouge refinery, have found a safe way around this problem. It is shown in the accompanying illustration.

Flow of the 125-psi test steam to the turbine is under instant, and constant, shut-off control by means of a relatively simple hook-up. The operator keeps his foot constantly on a pedal-operated, three-way valve while the test is being run. With the foot pedal down, 15-psi air flows through a 3-way valve and out to the atmosphere. The same 15-psi air line is connected to the diaphragm of the control valve on the test-steam line to the turbine.

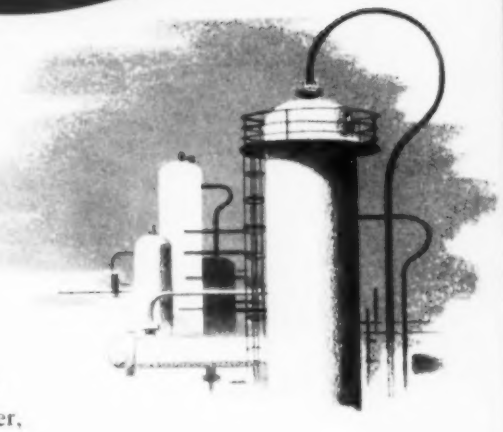
If trouble occurs, the operator yanks his foot off the pedal. As he does so the valve closes and air flow stops. This closes the diaphragm control

(To obtain more data on advertised products see page 170)

Versatility

is TRADITIONAL at WESTERN

Versatility is important in TREATING



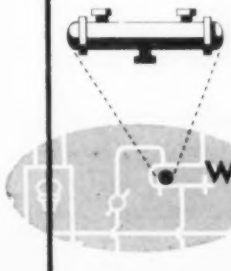
Treating petroleum fractions for the removal of sulphur, nitrogen, oxygen and other contaminants is a versatile hydrogenation process.

With a range of objectives which includes reduction in sulphur and nitrogen compounds—preparation of straight-run or cracked catalytic reforming feedstocks—improvement in odor, color, gum or storage stability, in burning properties, cetane number, lead susceptibility, and susceptibility to catalytic cracking—the equipment used in these process applications must provide an equal range of versatility.

Western Heat Exchangers are closely rated, carefully designed and accurately fabricated to meet the exacting demands of such treating processes—and merit *your* consideration and acceptance.

Western Heat Exchangers are used extensively and satisfactorily in hydrogen treating.

Western's representatives are at your command—**immediately.**



WESTERN

HEAT EXCHANGERS

WESTERN SUPPLY COMPANY

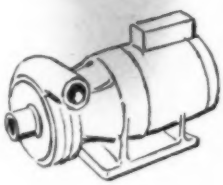
P. O. Box 1888 – Tulsa, Oklahoma

Nobody knows this RING BUSINESS like an old "PRO"

As a pioneer manufacturer of mechanical packings, Allpax has had extensive experience in developing and fabricating packing materials for the most exacting requirements of industry. Allpax rings for valves and pumps have proved themselves consistent winners through performance and preference in the field. All types are supplied in either molded, mandrel cut or endless form with butt or mitre joints.

✔ *For manufacturers —*
Allpax Rings cut costs and do a better job because they are precision-made in a complete range of sizes and a wide variety of materials. Right types available for each pump or valve requirement for whatever material handled.

✔ *For replacement —*
Accurate dimensions and proper types make replacement easier — insure a tight seal without danger of scoring or unnecessary wear on shafts or valve stems.



Use Allpax rings for:

GENERAL SERVICE • PETROLEUM SERVICE • STEAM • WATER • AIR • HIGH and LOW TEMPERATURE • ACID and CHEMICAL SERVICE ETC.

Each ring made to exacting packing requirements

ALLPAX

"The Packing that Packs All"

SEND FOR OUR CATALOG — TODAY!

A complete line of packing, tools, gasket materials
Distributors in principal cities

THE ALLPAX COMPANY, INC.
160 Jefferson Ave., Mamaroneck, N. Y.
CANADIAN DISTRIBUTORS: Albion Asbestos Packings Ltd., Montreal 8, Quebec

valve in the steam line, shutting off the 125-psi steam to the turbine.

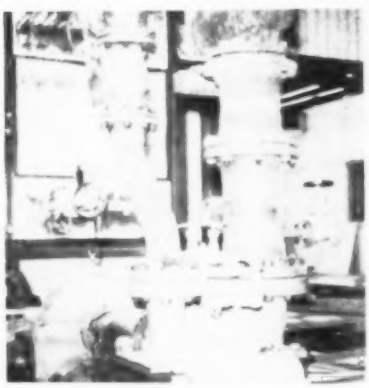
As a result: the operator has both his hands free for running the test and can leave the spot instantly when trouble hits, knowing the steam will shut off as he leaves.

Need a better instrument pen?

HYPODERMIC needles converted into integrator pens are cutting instrument maintenance costs for Humble Oil and Refining Company at Houston, Texas.

The new pens are made from hypodermic needles by cutting the needles to length and lathe-turning the barrels to fit integrator arms. Besides being initially cheaper than conventional replacement pens, the needle type pen has a longer life and makes finer, more easily read lines, says Humble.

Devised by Edward L. Maler, senior office machines mechanic in the Houston office equipment repair shop, the new pens also cut calibration time. Because of longer pen life, integrators need calibrating less often to compensate for pen wear.



Extra Pipe Spool Speeds Pump Maintenance

REMOVING the line strainer from the suction side of a pump may often require shutting down the entire pumping system. But at Shell Oil Co.'s Wood River, Illinois, refinery this is being avoided by using a second spool and a blind spectacle flange.

The second spool is installed upstream from the strainer spool, which is located next to the pump. By turning the spectacle "blind," the strainer downstream can be removed easily for cleaning without a general shutdown of the piping system.

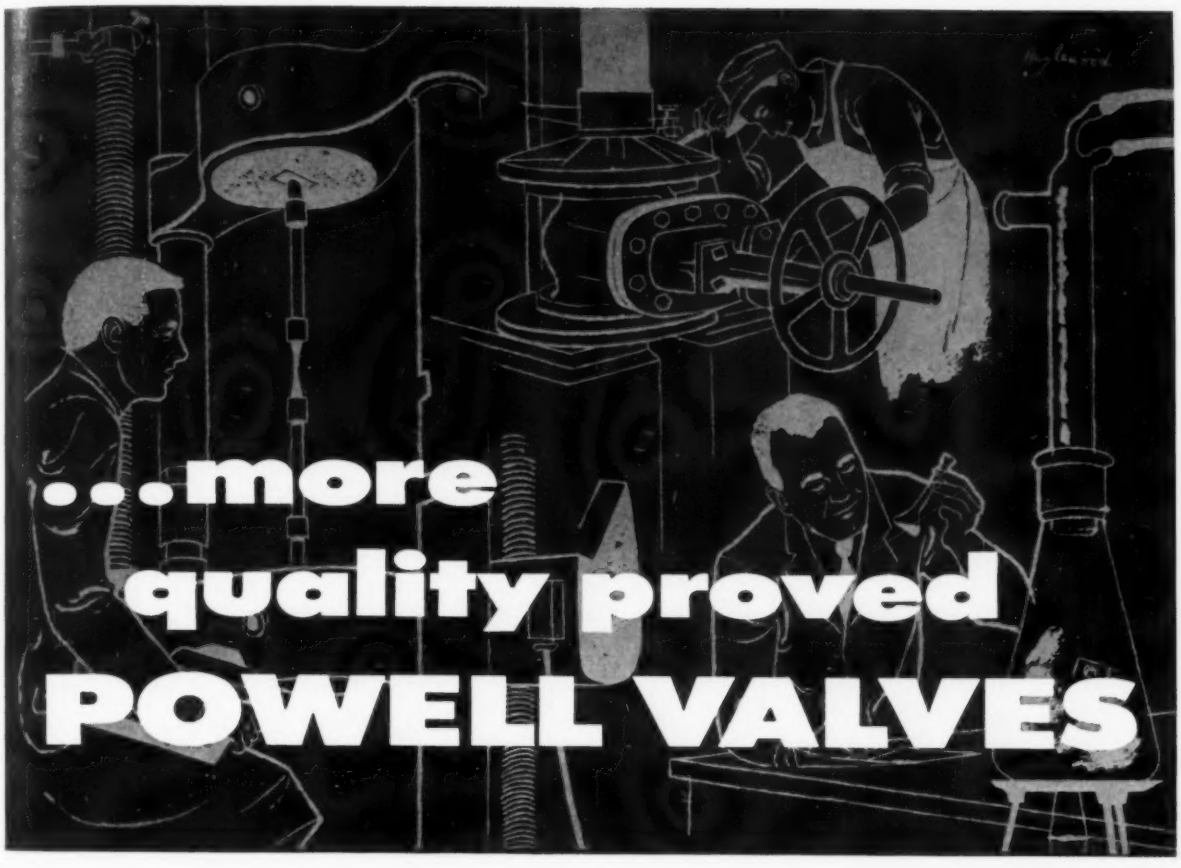
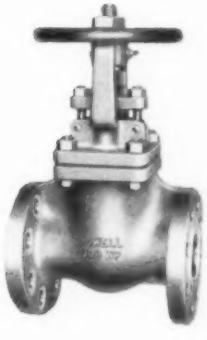


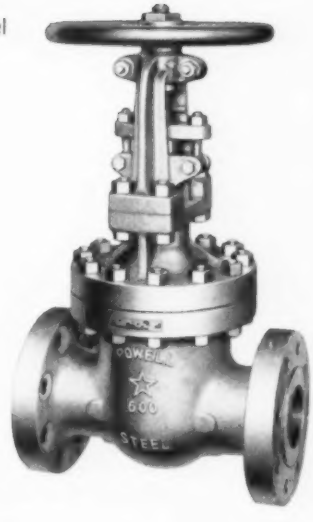
FIG. 375—Bronze "White Star" Gate Valve for 200 pounds W.S.P.

FIG. 2467—Stainless steel O.S. & Y. Gate Valve for 300 pounds W.P.

FIG. 6003—600-pound Steel O.S. & Y. Gate Valve

FIG. 3061—300-pound Steel Swing Check Valve





for dependable flow control

Consult your Powell Valve distributor for full facts about quality proved bronze, iron, steel and corrosion-resistant valves. For every flow control problem—there is a Powell Valve to solve it.

THE WM. POWELL COMPANY, CINCINNATI 22, OHIO . . . 111th YEAR

All materials pass through EVER-TITE Couplings in this

ESSO

blending operation

Installation of Ever-Tite Heavy Duty Couplings with Dust Plugs

In refineries, too—

EVER-TITE

QUALITY QUICK COUPLINGS

speed operations

EVER-TITE Adapter and Coupler

EVER-TITE Shank Hose Coupling

Install dependable EVER-TITE Couplings in

loading racks

•

manifolds in storage areas

•

manifolds in blending operations

•

container filling devices

•

fire hydrants and water lines

•

acid handling at storage and transfer locations

The installation pictured above, showing Ever-Tite Couplings in an Esso blending plant, typifies a trend in refineries everywhere. More and more refineries and petrochem plants are using Ever-Tite Couplings to speed operations, prevent leakage, and reduce losses of product.

There are many applications for Ever-Tite in a modern refinery—as indicated in the list at the left—where the dependable performance of Ever-Tite Couplings can effect definite economies.

Ever-Tites can do a *better* job because they are better engineered. To make a good tight connection just slip the coupler over the adapter and close the handles.

In every operation that calls for couplings it pays to standardize on EVER-TITE. Ask your distributor for full details.

Brass • Aluminum • Stainless Steel • Malleable Iron

Other materials available on request

EVER-TITE COUPLING CO. INC.
254 West 54th Street, New York 19, N. Y.

"Zey don' lak sand or gravel 'cause eet scratch zair bellies"

Frenchy, the Crawfish, and Me

TALK about peculiar situations—we really have our share around here. We'd built a small fresh water reservoir at the north end of the plant. It had just been finished and filled with water about a month when it suddenly started leaking like the Fountain of Versailles. Besides making one muddy mess of the north end of the plant, it was losing us a lot of water.

The contractor who had built the reservoir was a small-time operator named Marty Simms. Now Marty is a character who is very particular with a dollar and he was not at all interested in repairing leaky levees. Just the same, the Old Man had instructed me to call Marty out and give him a bad time to see what we could get out of him.

"I followed the specifications," Marty said over a cup of coffee in the Bull Pen; we were waiting for the reservoir to drain.

"Then you got nothing to worry about, Marty," I said. Marty was in a sweat.

"I followed the specifications." Marty sounded like a broken record.

"Yeah, Marty."

Dan Miretti came in. "That pond's drained if you want to take a look at it, but there's nothing wrong with the levees. I can't tell where the water's getting through."

"See? I told you I followed the specifications." Marty looked healthy for the first time that morning.

We all went out to take a look. We sloshed up and down the levees for an hour trying to find where they were leaking.

"Marty, you must have used the wrong kind of dirt for these walls."

"Like hell I did. I followed the specifications."

Finally Dan got to poking around the base of the levee. "Hey, look! Crawfish holes all along the levee!"

Well, I couldn't claim even a casual acquaintance with a crawfish, so I didn't have the wildest idea of how to handle the situation. One thing was sure, though—with the hot months coming on we had to have the water, so the critters had to go.

All I could suggest to the Old Man was to concrete the water side of the levee. "Or maybe we can poison 'em," I said.

"Our water's bad enough now without you fouling it up even more. What we need is an expert on crawdads," the Old Man said. He was stumped, too. "And I think we've got that expert right here in this plant."

Well, I couldn't imagine anyone around here with enough time to become an expert even on something important, not to mention crawfish. "And just who is your expert on crawfish?" I asked.

"Frenchy LeBlanc."

Now Frenchy is the last person in the world I would have figured to be any kind of an expert. But, being from the Cajun country, it figured that if anyone knew anything about crawfish, it would be Frenchy. He's what we call a 24-carat Cajun.

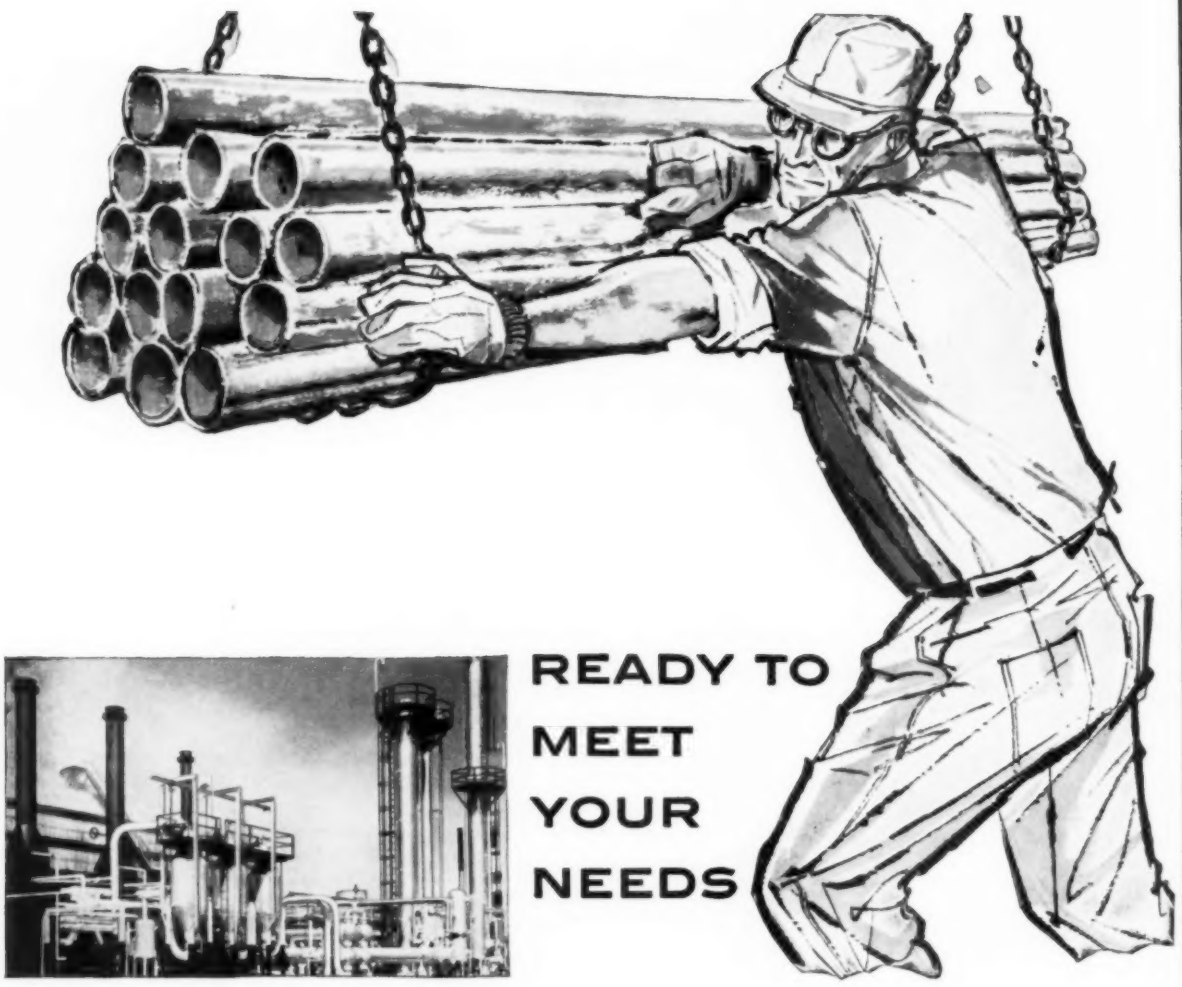
I went out and found Frenchy and took him up to the Old Man's office. That afternoon, we got an education on crawfish—how to catch 'em, how to eat 'em, and how to get rid of 'em.

The next morning, with Frenchy supervising the operation, we solved our problem. We had six trucks hauling gravel to the reservoir all day and a clam-shell crane depositing the gravel on the water side of the levee. By the end of the day, we had lined the inside walls of the reservoir with a layer of gravel about 3 in. thick.

We filled the tank with water again. The thing continued to leak for about a month, then it started to slow down and soon our troubles were over. I don't know where the crawfish went, but they sure stayed away from the levees.

In Frenchy's words—"Zem crawfish lak mud to dig zair holes in. Zey don' lak sand or gravel 'cause it scratch zair bellies. But de bes' t'ing to do wiz a crawfish is to make heem into a bisque an' eat heem!"

Next month read about how the Old Man's fair haired boy outfoxes a balky exchanger.



READY TO MEET YOUR NEEDS

THERMALLOY* CENTRIFUGALLY CAST

REFORMER FURNACE TUBES

Recent expansion of Electro-Alloys' centrifugal casting facilities means we can better meet your needs for Reformer Tube Assemblies. Even more important, you are assured of assemblies that are stronger, free of leaks . . . that last longer without warping or cracking.

Here's why!

1. Thermalloy tube sections are centrifugally cast to your specific diameters . . . to insure greater density, finer grain structure and uniform thickness.
2. Technicians control the soundness of tube sections, by X-raying and pressure testing.
3. Skilled Electro-Alloys metallurgists and engineers help you select the grade of Thermalloy heat-resistant alloy best suited to your specific application.

For further information on Thermalloy Reformer Furnace Tube Assemblies, call your nearby Electro-Alloys representative. Or write for Bulletin T-283. Electro-Alloys Division, 8073 Taylor Street, Elyria, Ohio.

*Reg. U. S. Pat. Off.

THERMALLOY TUBE SUPPORTS . . .

wall tube brackets and intermediate tube supports are also available. Or let us quote on your specifications.

AMERICAN Brake Shoe COMPANY

ELECTRO-ALLOYS DIVISION Elyria, Ohio

Do You Know These Words?

By B. H. WEIL
Manager, Information Services
Ethyl Corp. Res. & Engrg. Dept.
Detroit, Mich.

A regular department intended to help administrators and operating men keep abreast of technical names and processes in the petrochemical field.

Acrylic acid

Acrylic acid, pronounced "ah-**krill**-ick ass-id," is a colorless, acrid liquid best known for a property which characterizes its use: it polymerizes readily. It has the formula CH_2:CHCOOH, which accounts for another one of its several names—ethylene carboxylic acid. A little heavier than water per unit volume, it boils somewhat above the corresponding temperature for water but freezes at 54°F.

Acrylic acid, as its name testifies, is one of the raw materials (the others are methacrylic acid and acrylonitrile) for the "acrylic resins"—materials which range from semi-fluids to hard solids. These find uses ranging from dentures through protective coatings to adhesives, textile finishes, and lube-oil additives. Acrylic acid is also employed in the synthesis of other organic chemicals.

Commercially, acrylic acid can be manufactured in several ways: (1) from ethylene cyanohydrin, itself a derivative of ethylene oxide and hydrogen cyanide; (2) from acetylene, "by a modified Reppe approach"; (3) from *beta*- propiolactone, a derivative of formaldehyde and ketene (itself derived from acetone or acetic acid); (4) oxidation of acrolein; and (5) hydrolysis of acrylonitrile. Space does not permit tracing all these petrochemicals (they all are!) back to the petroleum fractions from which they are derived, but most of these intermediates have already been described in this series.

Acrylic acid, as may be judged by the diversity of its many methods of synthesis, is a petrochemical which is of considerable commercial interest. While it is not quite as well known as its cousins—acrylonitrile and methacrylic acid—its producers hope that it will take more of the spotlight in the future.

Tolylene diisocyanate

Tolylene diisocyanate, quite a mouthful of a petrochemical to pronounce (**tahl**-il-een dye-**eye**-sew-**sigh**-ah-nate), is also quite an important new petrochemical. It is one of the diisocyanates mentioned in the September, 1955, installment of this series as a raw material for the exciting new urethane plastics and rubbers. A colorless to yellowish liquid with a medicinal odor, it has the formula $CH_3 \cdot C_6H_3 (NCO)_2$. The commercial product has the two isocyanate groups ($\cdot NCO$) chiefly in the *meta* position. That is they are attached to the second and fourth carbon atoms of the six-carbon-atom benzene ring, to the first atom of which a $\cdot CH_3$ group is attached. But 20% of the commercial mixture is the 2, 6-diisocyanate.

Tolylene diisocyanate, a toluene derivative, is produced by quite a series of reactions, which is typical of the more complex petrochemical syntheses and the reason for the high cost of chemicals based on relatively inexpensive petroleum materials. In its synthesis, toluene is first nitrated (reacted with nitric acid) to yield the dinitro compound. This is reduced (reacted with hydrogen) to yield the diamine (compound containing two $\cdot NH_2$ groups). The diamine is then reacted with phosgene (a well-known "poison gas," prepared from carbon monoxide and chlorine) to produce the diisocyanate.

As can be seen, quite a number of petrochemicals are involved in this synthesis—toluene from naphtha reforming, nitric acid from natural gas (via ammonia synthesis), and hydrogen and carbon monoxide (produced from the partial oxidation of natural gas, or its reaction with steam).

The urethanes, produced from tolylene diisocyanate (or similar diisocyanates) and various other intermediates, are already being widely applied as foamed-in-place plastics, protective coatings, adhesives, and rubbers. Increased production seems certain.

NEWS in VIEWS

POLYOLEFIN RESIN is the end-product of this process piping section of Celanese's just-on-stream plant at Houston. The 40 million lb/yr plant sits on a 220-acre site near the ship channel.

to all NATURAL GASOLINE MEN

GREETINGS

from the

NATURAL GASOLINE SUPPLY MEN'S ASSOCIATION

We are looking forward to seeing you at the
Thirty-Sixth Annual Convention of the
Natural Gasoline Association of America
APRIL 24-26, 1957
RICE HOTEL, HOUSTON, TEXAS

Members of the Natural Gasoline Supply Men's Association:

The Aber Company
Air Products, Inc.
Airetool Mfg. Co.
M. N. Aitken Company
Alco Products, Inc.
Alliger and Sears Co.
Allis-Chalmers Manufacturing Co.
Aluminum Company of America
American Air Filter Company, Inc.
American Meter Company, Inc.
Aquatrol, Inc.
Armco Drainage & Metal Products, Inc.
Arrow Industrial Manufacturing Co.

Barton Instrument Corp.
J. B. Beaird Company, Inc.
Bellco Industrial Engineering Co.
Berry Hydraulics—
Div. Oliver Tyrone Corp.
The Belmas Co., Inc.
Bethlehem Supply Company
W. H. & L. D. Betz
The Bird-Archer Company
Black, Sivalls & Bryson, Inc.
Bowden Construction Co., Inc.
Braden Steel Corp.
L. J. Brammer & Sons
C. F. Braun & Co.
The Brown Fintube Co.
Brown and Root, Inc.
Burgess-Manning Co.
Butane-Propane News
Bryon Jackson Company

Cameron Iron Works, Inc.
John H. Carter Co.
Chicago Bridge and Iron Co.
Clark Bros. Co., Inc.
Climax Engine & Pump Mfg. Co.
Clowe & Cowan, Inc.
The Condit Company
Continental Products of Texas
Continental Supply Co.
C. Lee Cook Manufacturing Co.
The Cooper-Bessmer Corp.
S. C. Covington Co., Inc.
Joseph A. Coy Company, Inc.
Crane Packing Company
W. H. Curtin and Company

Dallas Tank Company, Inc.
Daniel Orifice Fitting Company
Davis Regulator Company
Davison Chemical Company
Dean Brothers Pumps, Inc.
Dearborn Chemical Co.
De Laval Steam Turbine Company
Delta Engineering Corporation
Dresser Engineering Co.
Dunham Tanks Div., Anderson Dunham, Inc.
E. I. duPont deNemours and Co., Inc.

Allen Edwards, Inc.
Eggelhof Engineers
John W. Elder Company
Elliott Company
Elsey Corporation
Engine Life Products Corp.
Engineering Equipment Co.
Engineers and Fabricators, Inc.
Ethyl Corporation

Farnsworth & Chambers Co., Inc.
Farris Engineering Corp.
The Fish Engineering Corp.
The Fisher Governor Company
Flint Steel Corp.
Flow Measurement Co.
The Fluor Corporation, Ltd.
Fluor Products Company
The Foxboro Company
France Packing Company

Gardner-Denver Co.
Garlock Packing Company
Gas Equipment Co., Inc.
Gasoline Plant Construction Corp.
General Electric Company
J. B. Gill Company, Inc.
Goulds Pumps, Inc.
Graver Tank & Manufacturing Co., Inc.
The Griscom-Russell Company
Grove Valve & Regulator Co.
Gulf Engineering Co., Inc.

D. W. Haering and Company, Inc.
Hammel-Dahl Co.
The Happy Company
Wyatt C. Hedrick Engineering Corp.
Hercules-Lupfer Engine Sales Co.
T. F. Hudgins & Associates, Inc.
Hudson Engineering Corporation

Industrial Scientific, Inc.
Ingersoll-Rand Company
Insulation & Specialties, Inc.

Joy Manufacturing Co.

Kansas Paint & Color Co.
The M. W. Kellogg Company
The Koch Engineering Company
James S. Kone & Co.

Ladish Company
Max E. Landry, Inc.
Warner Lewis Company
A. M. Lockett and Company, Ltd.
Lubricosos Specialties Mfg. Co.
The Lunkenheimer Company

Maintenance Engineering Corp.
F. H. Maloney Company
Maloney Crawford Tank & Mfg. Co.
Manco Engineering Co.
Manning, Maxwell and Moore
Manzel
Market Dev. Div.—Phillips Petroleum Co.
The Marley Company, Inc.
Chas. Martin & Co.
Marsh Instrument & Valve Co.
The Marsh Co.
Massey Machine Div., Curtiss-Wright Corp.
C. A. Mathey Machine Works
Lynn McGuffy Co.
J. R. Meek Company
Mid-Continent Supply Company
Minneapolis-Honeywell Regulator Co.
Moorlane Company
Moran Furnace and Sheet Metal Co.

National Aluminate Corp.
National Tank Company
Natural Gas Odorizing Co., Inc.
Naylor Pipe Company
Nickles Machine Corp.
Nordstrom Valve Div., Rockwell Mfg. Co.
Wm. W. Nugent & Company, Inc.
Nutter Engineering Co.

The Ohio Injector Co.
The Oil Daily
The Oil and Gas Journal
Oil Well Supply Div.—U. S. Steel Corp.
Olin Mathieson Chemical Corp.
O. L. Olsen Co.
Orbit Valve Company

Pacific Pumps, Inc.
Paramount Supply Company
Peerless Manufacturing Company
Perry Equipment Corporation
Petro-Chem Development Co., Inc.
Petrocon Engineering Co., Inc.
The Petroleum Engineer
Petroleum Processing
Petroleum Refiner
Petroleum Week
Pierce Construction Co.
Pittsburgh Div., Rockwell Mfg. Co.
Pilbrico Company
Podbielniak, Inc.
Power Machinery Company
Power Specialty Co.
J. F. Pritchard & Co.
Process Equipment Company
Puffer-Sweiven Co.

Edw. G. Ragatz Co.
Rawson & Co.
The Refinery Supply Company
Riddle and Hubbell
Robinson Orifice Fitting Co.
Rockwood Sprinkler Co.
Rogers Steel Corp.

E. W. Saybolt and Company
A. O. Smith Corporation
Smitheo Engineering, Inc.
Snyder Company, Inc.
Southern Engine & Pump Co.
Southwest Industries, Inc.
N. C. Stearns Co.
Stearns-Roger Manufacturing Co.
Stitt Ignition Co.
Stockham Valves & Fittings
Superior Manufacturing Company

Taylor Forge and Pipe Works
Taylor Instrument Companies
Tellespen Petro-Chem Constructors
The Tennant Company
Termomeccanica Italiana
Tube Turns Div.—National Cylinder Gas Co.
Tuloma Builders, Inc.
Tyler-Dawson Supply Co.

Union Steam Pump Sales Company
United Centrifugal Pumps
United Chemical Corp.
Universal Oil Products Co.

Vinson Supply Company
Vulcan Steel Tank Corp.

Walco Engineering and Construction Co.
Walworth Company
Well Equip. Div.—Chikson Co.
Westcott and Greis, Inc.
Western Chemical & Supply Co.
Western Chemical Co. of K. C. Mo.
Western Supply Company
The Wickes Boiler Co.
Wilson Supply Co.
Woodbank Machinery Company
World Petroleum
Worthington Corp.
Wright Chemical Corp.
Wyatt Metal and Boiler Works

John Zink Burner Company

WPRA to talk asphalt at annual meeting

AN ASPHALT symposium will highlight the annual meeting of the Western Petroleum Refiners Association, to be held in the Hilton Hotel, San Antonio, March 25-27.

Speakers on the symposium will be Arvins S. Wellborn, chief engineer, Asphalt Institute; W. B. Warden, Miller-Warden Associates; and John S. Pfarr, manufacturing vice-president, Leonard Refineries. Presiding will be C. W. Berger, chairman of the WPRA asphalt committee. Topics of the papers had not been announced by press-time.

Technical sessions at the meeting will include these papers:

"New Automotive Power Plants—Their Fuels and Lubricants," by G. C. A. Rose, Caterpillar Tractor Co.

"Octanes, Olefins, and Road Performance," by T. O. Wagner and N. D. Esau, Standard Oil Co. (Ind.), and J. D. Bailie and F. C. Burstetta, Ethyl Corp.

"Asphalt as It Affects the Refining Industry—Past, Present and Future," by D. W. Gagle, Phillips Petroleum Co.

"Sulfuric Acid Alkylation Unit at the Toledo Refinery of Sun Oil Co.," by Dr. C. H. Brooks and J. P. Daugherty, Sun Oil Co.

"Economics of Producing High Octane Pool Gasoline," by S. W. Curry, Universal Oil Products Co.

"Pentane-Hexane Processing," by E. F. Schwarzenbek, M. W. Kellogg Co.

"Urea Dewaxing for Low-Cold-Test Oils," by T. H. Rogers, Standard Oil Co. (Ind.).

"Catalytic Cracking with Kaolin Catalyst," by D. Beyler, J. B. Maerker, and J. W. Schall, Houdry Process Corp.

Turn page for more Meetings

Computers group to meet in Houston, June 19-21

The 12th annual meeting of the Association for Computing Machinery will be held June 19-21 on the campus of the University of Houston, Houston, Texas. Program will be available around May 1 and may be had by writing the Association at the University—address, Cullen Blvd., Houston 4.

"Catalysis" is AIChe group's topic, Apr. 9

"Catalysis in Practice" is the theme for the April 9 meeting of the Philadelphia-Wilmington Section of the American Institute of Chemical Engineers. Site of the event will be the University of Pennsylvania.

Speakers at the morning session, and their topics, are as follows:

"Which Catalyst and Why?" by Alex Oblad, Houdry Process Corp.

"Preparing an Industrial Catalyst," by Frank G. Ciapetta, C. D. Helm, and L. D. Barrel, Davison Chemical Co.

"Fixed-Bed Catalyst Systems," by A. B. Stiles, Du Pont Co.

"Moving-Bed Catalyst Systems," by J. M. Bourguet and S. J. Wantuck, Socony Mobil Oil Co.

In the afternoon, these will be the papers and speakers:

"Economics of Catalyst Use," by Dr. R. M. Reitmaier, Girdler Corp.

"Operating Problems," by J. M. Harris, Rohm & Haas Co.

"Trends and Prospects," by C. G. Kirkbride and C. L. Thomas, Sun Oil Co.

Oil man's calendar

Boldface items reviewed in this issue

MARCH

18-21 Society of the Plastics Industry, annual, Los Angeles-Biltmore Hotel, Los Angeles
18-21 Gas Turbine Power Conference, ASME, Sheraton-Cadillac, Detroit
25-27 Western Petroleum Refiners Assn., annual, Hilton Plaza, San Antonio, Texas
27-28 Engineering Management Conference, ASME, Penn Hotel, Pittsburgh

APRIL

3-5 Corrosion Control Short Course, Central Oklahoma Section of the NACE and U. of Oklahoma, Extension Study Center, Norman, Okla.
7-10 3rd Instrument and Regulators Conference, ASME, Northwestern U., Evanston, Ill.
7-12 American Chemical Society, national meeting, Miami
8-10 American Society of Mechanical Engineers, spring meeting, Dinkler-Tutwiler Hotel, Birmingham, Ala.
9 American Institute of Chemical Engineers, Philadelphia - Wilmington chapter, U. of Pennsylvania
9-11 5th Welding Show, American Welding Society, Philadelphia
10-12 National Nuclear Instrumentation Conference, Instrument Society of America, Atlanta, Ga.
16-18 National Petroleum Assn., semi-annual, Hotel Cleveland, Cleveland, Ohio
16-18 Southwestern Gas Measurement Short Course, U. of Oklahoma, Norman
19 Assn of Consulting Chemists and Chemical Engineeers, dinner meeting, Belmont Plaza Hotel, New York City
24-26 Petroleum Corrosion Conference, International Nickel Co., Wrightsville Beach, N. C.
24-26 Natural Gasoline Assn. of America, annual, Rice Hotel, Houston
29-30 Automatic Control in the Petroleum and Chemical Industries, U. of Oklahoma conference, Norman, Oklahoma
29-May 3 7th Materials Handling Exposition, Convention Hall, Philadelphia, Pa.

MAY

5-11 Cuban Congress on Petroleum, Havana
13-15 Industrial Waste Conference, Purdue University, Lafayette, Ind.
13-16 American Petroleum Institute, Division of Refining mid-year meeting, Sheraton Hotel, Philadelphia
20-23 Design Engineering Show, ASME, Coliseum, New York
20-24 National Fire Protection Assn. Hotel Statler, Los Angeles

JUNE

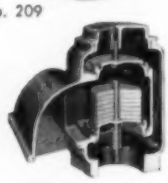
2-5 Chemical Institute of Canada, annual, Vancouver, B. C.
2-7 Society of Automotive Engineers, summer meeting, Chalfonte-Haddon Hall, Atlantic City
6 Pennsylvania Grade Crude Oil Assn., annual, Penn-Sheraton, Pittsburgh
9-12 American Institute of Chemical Engineers, national, Olympic Hotel, Seattle, Wash.
9-13 American Society of Mechanical Engineers, semiannual, Sheraton Palace Hotel, San Francisco
11-13 Western Plant Maintenance and Engineering Show, San Francisco
16-18 American Society for Testing Materials, annual, Chalfonte-Haddon Hall, Atlantic City
19-21 Assn. for Computing Machinery, annual, U. of Houston, Houston
24-28 American Institute of Electrical Engineers, summer general, Montreal, Que.

Prevent costly vapor loss with pressurized

OPW TANK VENTS

No. 209 10"

No. 209



No. 395

No. 514

- ABOVE GROUND STORAGE TANKS
- UNDERGROUND STORAGE TANKS
- SMALL HOME STORAGE TANKS
- FARM SKID TANKS

No. 95

There's a vapor saving OPW Tank Vent for every purpose. Precision machined, product engineered for lifetime use, they are your INVESTMENT against vapor loss due to product expansion and temperature variation. Weighted to specifications, OPW Tank Vents trap and hold vapors and release only at set pressures, insuring maximum protection and dollar dividends. Double mesh screen readily accessible for inspection maintains bulk storage safety.

Send for OPW Tank Venting and Emergency Relief Recommendation Chart!

JORDAN CORPORATION

6013 Wiehe Road
Cincinnati 13, Ohio
ELmhurst 1-1352

OPW

"The Changing Pattern in Petrochemicals," by George H. Weber, *Oil & Gas Journal*.

Presiding at the three sessions will be D. G. Morgan, D-X Sunray Oil Co.; W. F. Brown, Continental Oil Co.; and W. K. Bergen, Standard Oil Co. (Ohio).

ASME engineer panel to discuss development

The spring meeting of the American Society of Mechanical Engineers will devote one of its sessions to a panel on the professional development of the young engineer. The meeting is scheduled for April 8-10 at the Dinkler-Tutwiler Hotel in Birmingham, Ala.

Members of the panel will be:

Lonnie B. White, Jr., U. S. Steel Corp., with the topic, "The Young Engineer's Professional Development in the Training Program of the Large Corporation."

William B. Speir, the Rust Engineering Co., "The Young Engineer's Professional Development in the Training Program of the Small Company."

Erskine Vandegrift, Jr., American Cast Iron Pipe Co., "Can Technical Societies Help the Young Engineer."

Andrew H. Payne, Jr., a consulting engineeer of Birmingham, "Registering as a Professional Engineer."

A selection of papers from the other seven sessions follows:

"Newest Techniques in Managing Maintenance," by Oswald Stewart, *Factory* magazine, McGraw-Hill Publishing Co.

"Charts and Graphs that Help Solve Materials Handling Problems," by R. M. Staton, Georgia Institute of Technology.

"Component Fatigue Analysis for Maintenance," by Roy J. Laux, Du Pont Co.

"Cost Control Can Be the Answer for Materials Handling Problems," by John B. Day, Georgia Institute of Technology.

"The Fork Truck's Place in the Materials Handling Picture," by George Smith, Yale & Towne Mfg. Co.

"The Engineer's Place in Management," by John W. Little, Goslin-Birmingham Mfg. Co.

"Techniques of Drawing in the Third Dimension," by David Gordon, Mechanical Draftsman.

SAE "meeting memo"

Piston engine is still sovereign

Detroit—The automobile industry is buckling down to make the most it can out of the piston-type engine during the coming eight or ten years, judging from the tenor of papers presented and the lobby talk here at the annual meeting of the Society of Automotive Engineers.

This year there was no formal discussion of the gas turbine powered passenger car, as there was at the past two annual meetings, or other revolutionary type engines. Three papers on small gas turbines limit their application to aircraft propulsion. The Nuclear Advisory Committee of the SAE reported that "unless a completely new and revolutionary scientific principle is discovered, nuclear power plants will always remain much too heavy for the propulsion of automobiles and trucks."

Forthcoming improvements in the piston-type automobile engines that were the subject of SAE papers were presented in terms of economies in operation, as well as improved performance. Other papers reported studies of fleet operations — how to achieve fuel economy and thereby reduce the cost of operating the fleet.

The General Motors fuel injection system, now a commercial development, was introduced to the SAE with the statement that "a fuel system capable of correcting even 50% of the average carburetor deficiencies may produce a 10% improvement in fuel economy that will ultimately result in substantial savings to the customer." The Bendix Aviation Corp's electronic fuel injection system, now approaching the commercial stage, was described as allowing wider latitude in fuel selection. For a further discussion of fuel injection, see pp. 59-62 of this issue.

A paper given by the Pacific Telephone and Telegraph Co. told how training drivers increased the gasoline mileage of its fleet of 4000 vehicles an average of one mile per gallon of gasoline, thereby effecting a $40,000 annual saving. A Gulf Oil Corp. automotive engineer reported on work done on behalf of the Greyhound Corp. to secure better fuel economy in its diesel engine powered buses.

Perhaps discussions in this field are a forerunner of the day, which

(To obtain more data on advertised products see page 170)

some people think is already long overdue, when fuel and other concrete economies in car operation will be talked about when the new models are introduced, as well as the increased car length, the glamorous interiors and the futuristic sweep of the fenders. V. B. GUTHRIE

New process uses two fuels in diesels: Sinclair Research Laboratories Inc. recently working in cooperation with Fairbanks, Morse & Co., has developed a system using two fuels, primarily for application in stationary-type diesel engines. In the case of a two-cycle engine, a small amount, 5 to 15%, of an auxiliary fuel is introduced directly into the cylinder of a two-cycle engine by means of a properly timed second nozzle. In a four-cycle engine the auxiliary fuel is introduced just ahead of the air intake valves by means of individual low-pressure nozzles. A conventional fuel system is used for the primary fuels. Useful auxiliary fuels have certain basic characteristics: (1) low spontaneous ignition temperature at 500°F or below, (2) cetane number of 50 and above, (3) marked pre-flame oxidation characteristics. The Bi-Fuel Combustion Process allows a wide range of residual or distillate fuels as well as high octane stocks in the gasoline boiling range to be burned as primary fuel. In addition to allowing the use of low-quality fuels, the process reduces wear and deposits and increases the smoke limited power output. A patent is pending. "Bi-Fuel Approach to Burning Residual Fuels in Diesel Engines," by W. C. Arnold and R. H. Beadle, Fairbanks, Morse & Co., and R. L. Logelin and H. D. Young, Sinclair Research Laboratories, Inc., (5500 words, 7 tables, 23 illustrations) annual meeting, Society of Automotive Engineers, Detroit, Jan. 14-18, 1957.

Saving fuel is up to the driver: A fleet operator of 4000 vehicles undertook a comprehensive program to increase its gasoline mileage one mile per gallon, which would effect an annual saving of $40,000. Equipping vehicles with 180° thermostats, choke controls and other mechanical changes made minor savings. A "defensive" driving program for all vehicle operators, using a mileage meter and vacuum gage, proved much more effective. Mileage increased from 10.3 miles/gal at the end of 1952 to 11.4 at the end of 1955. Also there were fewer accidents, improved brake and tire life, and less repairs. "Efficient Operation of Gasoline Powered Motor

For Every Corrosive Service

"JOHN CRANE" FreeFlow Construction
Gasket flush with pipe I.D.—allows completely unrestricted flow.
No air pocket—insert flush with I.D. of envelope. No danger of rupture due to expansion of entrapped air at high temperatures.
AIR
Ordinary "Wishbone" Construction
Envelope extends beyond I. D. of pipe, causing flow restriction and turbulence.
Expansion of entrapped air at high temperatures presents danger of gasket rupture.

JOHN CRANE

FreeFlow
GASKETS made of TEFLON*

"John Crane's" FreeFlow construction and chemically inert Teflon have been combined as *the* answer for gaskets in corrosive service. This new construction assures a flush fitting with the I.D. of the pipe and the inner wall of the Teflon envelope, not possible with the ordinary "wishbone" type gasket. (See drawing above).

This means elimination of:

1. Flow restriction and turbulence in the line.
2. Danger of rupture at high temperature due to entrapped air between gasket insert and Teflon envelope.

"John Crane" Teflon FreeFlow gaskets are impervious to practically every known chemical or gas and are unaffected by temperatures from −100° to +482°F., depending on the insert material. They are available in all shapes and sizes for a wide variety of applications, such as glass lined, porcelain, pyrex and similar equipment, including reactor kettles and pipes, distillation columns and nozzles.

Request full information on "John Crane" FreeFlow gaskets for your particular requirement. Ask for our informative booklet, *The Best in Teflon*, for other important technical and application data. Crane Packing Company, 6432 Oakton St., Morton Grove, Ill. (Chicago Suburb).

In Canada: Crane Packing Co., Ltd., Hamilton, Ont.

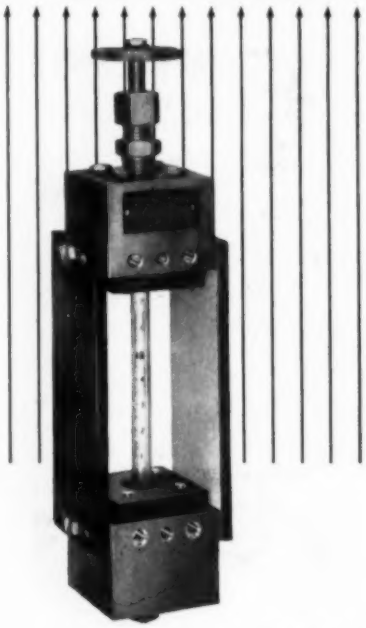
*DuPont trademark

JOHN CRANE CRANE PACKING COMPANY 38 YEARS INDUSTRIAL PROGRESS

(To obtain more data on advertised products see page 170)

BROOKS LEADERSHIP
achieved by design

a rugged purge meter
FOR HIGHER PRESSURES



Alone in its class . . . the Brooks Sho-Rate* "75" provides simplified, purge-meter dependability for flow applications ranging up to 500 psi at 280° F.

The Sho-Rate "75" Purge Meter incorporates the Brooks dowel-pin, side-plate construction — thus no worry about line strain and side torque. It's a rugged meter that can take its place along the process line, wherever small flow indication is required . . . yet its cost is moderate.

Sho-Rate "75" handles air flows ranging from 0.2 to 120 CFH; water from 0.1 to 30 GPH. Built-in outlet or inlet valves and constant differential relays are optional.

THREE COMPLETE LINES of purge meters are described—with pertinent applicational data—in Bulletin No. 120. Send for your copy.

*Trade-name

BROOKS ROTAMETER COMPANY
357 H STREET
Lansdale, Pennsylvania

A complete line...
BROOKS ROTAMETERS
...for every service

Meetings

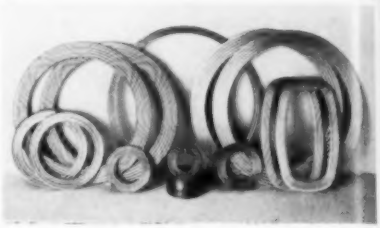
Vehicles," by A. A. Keefer, Motor Vehicle Supervisor, Pacific Telephone and Telegraph Co., (2000 words) annual meeting, Society of Automotive Engineers, Detroit, Jan. 14-18, 1957.

Phosphorus fuel additives lessen spark-plug fouling: A survey of spark plug fouling in 193 late-model passenger cars operated appreciable distances in city-suburban driving showed that approximately one third of the spark plug sets were fouled sufficiently to cause a 20% or greater decrease in vehicle performance. Dynamometer and road test procedures were developed for studying various factors affecting spark-plug fouling as well as expressing the degree of fouling. Changes in antiknock compound and fuel-sulfur concentration, as well as changes in fuel base stock composition, affect spark-plug fouling. Phosphorus fuel additives offer a commercial solution by at least doubling the time to spark-plug fouling. "Spark-Plug Fouling, A Survey—Test Procedures—Fuel Factors," by C. A. Hall, R. C. Beaubier, E. C. Marckwardt and R. L. Courtney, Research and Engineering Dept., Ethyl Corp., (6500 words, 20 illus.); annual meeting, Society of Automotive Engineers, Detroit, Jan. 14-17, 1957.

Demand for residual fuel oil will grow: Refining developments that have affected the supply of heavy fuel oils are reviewed. Of current requirements for these oils, industrial use represents about 31% of the total, marine use nearly 21%, heating oil requirements 15.5%. Expansion in all these fields points to a continuing growth in demand. Of the current supply in this country, about 75% is No. 6 grade, 20% No. 5 grade and 5% No. 4 grade. The wide range in API gravity, viscosity, heat content and other physical properties of the No. 6 grade emphasizes the need for flexible handling and combustion equipment in the various fields of utilization, even though modern processing methods and the use of additives can improve the properties of these oils for specific application. "Trends in Residual Fuels," by R. W. Van Sant, Jr., Chief Product Application Engineer, Domestic Marketing Dept., and A. S. Orr, Coordinators' Group, Manufacturing Dept., Gulf Oil Corp. (6500 words, 5 tables, 8 charts); annual meeting, Society of Automotive Engineers, Detroit, Jan. 14-18, 1957.

Try residual-distillate blends in railroad diesels: Stationary locomotive

Need Plain or Jacketed
CORRUGATED METAL
GASKETS?



Call CHICAGO-WILCOX
for PROMPT ATTENTION

Chicago-Wilcox understands the gasket requirements of refineries and is equipped to supply all types of gaskets, including plain or jacketed corrugated metal gaskets like these. Made of ingot iron, aluminum, stainless steel, copper, brass, nickel, and monel in all sizes and shapes.

Send specifications for quotations and prompt-delivery schedule.
Write for new catalog

CHICAGO-WILCOX MFG. CO.
7731 Avalon Avenue, Chicago 19, Ill.
Phone: SAginaw 1-1900

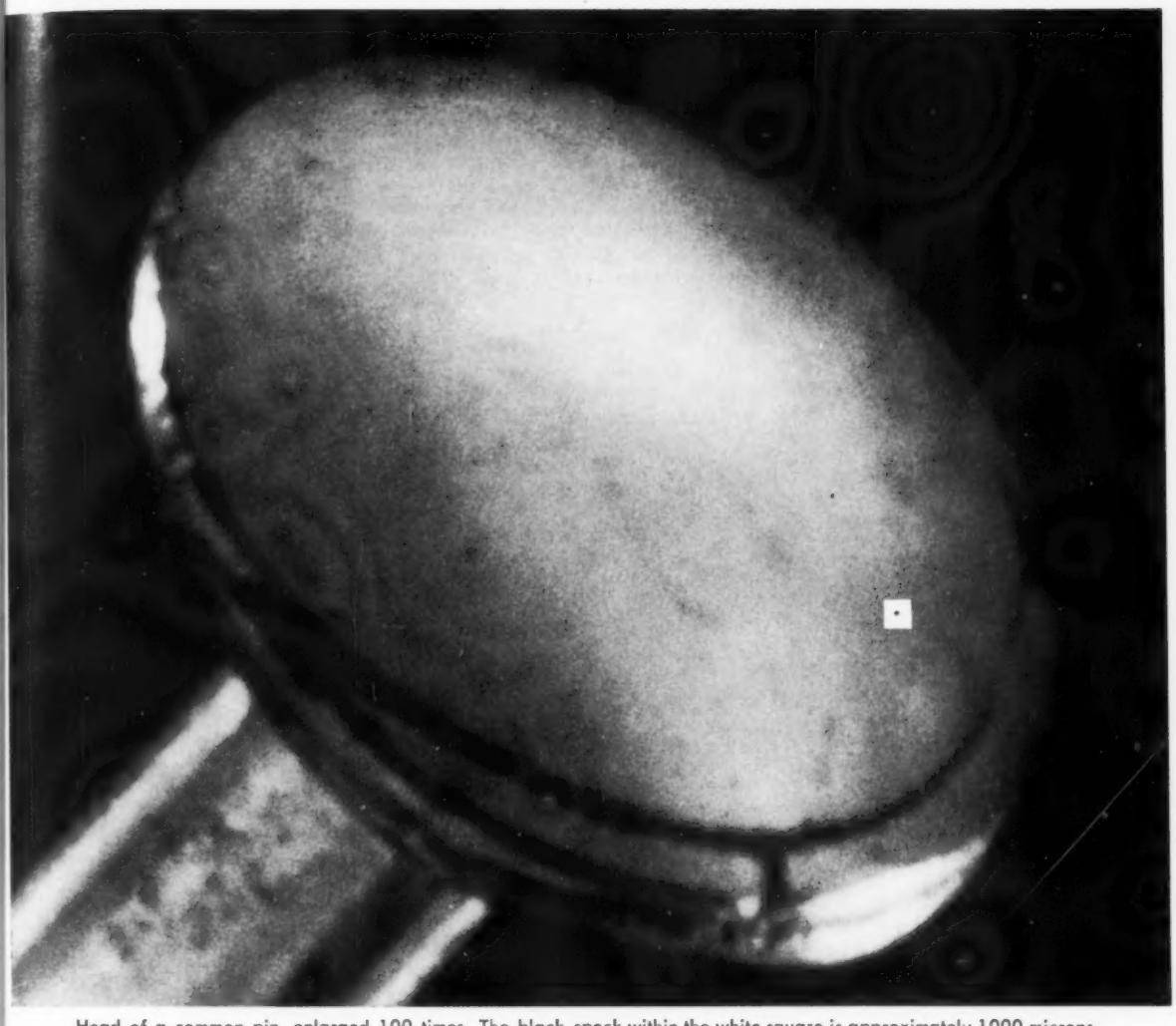
IMPROVE
YOUR
DRAFTING

Now available in reprint form . . . the popular series of four articles for PETROLEUM PROCESSING, July-October, 1956, "How To Improve Your Drafting Production."

How to turn out better drawings faster, save time with proper tools and methods, improve mental efficiency, present design data clearly and effectively.

PLUS: "Make - it - yourself" Slide Chart for quickly dimensioning valves and fittings for nominal pipe sizes, 150 and 300 lb. series. The chart is printed on sturdy card stock and is easily assembled.

Order Reprint R31 . . . . 24 pages plus Slide Chart $1.25
Use the Reader Service Card, pp. 171-172, this issue, or send order to PETROLEUM PROCESSING—330 West 42 Street—New York 36, N. Y.



Head of a common pin, enlarged 100 times. The black speck within the white square is approximately 1000 microns.

Micron on a pinhead!

It takes twenty microns to be visible to the naked eye. There are twenty-five of them in each white blood cell in your veins.

But a micron is too *large* for measurement in some of the filtration Purolator is doing today.

It's a fact. Some of our filters have to remove particles that are sub-micronic in size. That's how far we've come in keeping pace with today's demand for better performance and longer life in industrial equipment and consumer goods. As a result, precision fits, closer running clearances, smoother surface finishes and far more effective quality control are the rule . . . and this trend is continuing. That's why it is important that the potential savings be clearly understood by the people responsible for important decisions in this field.

Application of our engineering skill to the widest diversity of filtration problems for more than three decades has provided us with a unique experience. Whatever filtration problem industry runs into . . . chances are we've already solved it.

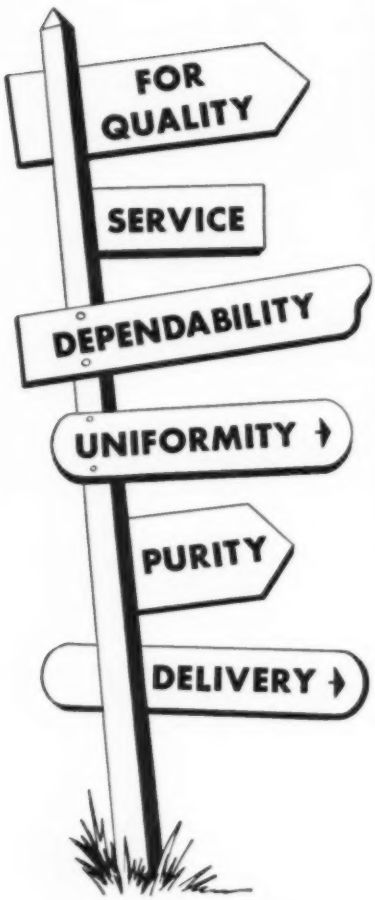
Filtration For Every Known Fluid

PUROLATOR

PRODUCTS, INC.

Rahway, New Jersey and Toronto, Ontario, Canada

(To obtain more data on advertised products see page 170)



...all roads lead to

SOLVAY ALUMINUM CHLORIDE

Write for SOLVAY Aluminum Chloride literature and prices. For specific information, include your question. No cost!

SOLVAY®

SOLVAY PROCESS DIVISION

Allied Chemical

ALLIED CHEMICAL & DYE CORPORATION
61 Broadway, New York 6, N. Y.

BRANCH SALES OFFICES

Boston • Charlotte • Chicago • Cincinnati • Cleveland
Detroit • Houston • New Orleans • New York
Philadelphia • Pittsburgh • St. Louis • Syracuse

tests conducted by the New York Central railroad have indicated that a residual-distillate type fuel gives satisfactory performance in a freight locomotive, when used in conjunction with a dual-fuel system. The three R/D fuels tested contained approximately 25%, 50% and 75%, respectively, of a selected residual component blended with a good quality distillate fuel. The viscosities of these fuels were 42, 65 and 300 SSU at 100°F. Use of a dual-fuel system was found necessary because operation with the R/D fuel below the fifth throttle position was unsatisfactory. The standard locomotive fuel system was retained for operation with distillate fuel through the fourth notch. A field test now in progress indicates deterioration of the lubricating oil may be accelerated with the R/D fuel. This problem is being investigated. "Heavy Fuels for Railroad Diesels," by W. F. Collins and K. D. Relyea, New York Central System; B. W. Geddes and N. H. Rickles, Esso Research and Engineeering Co. (8000 words, 16 illus., 1 appendix); annual meeting, Society of Automotive Engineers, Detroit, Jan. 14-18, 1957.

Why cars wear out in service: Debate in scientific circles over the cause of wear in passenger car rings and cylinders induced the Atlantic Refining Co. to include a wear test program in a long term road test on 12 vehicles. A radioactive cast iron top compression ring was installed in each car and all during the test oil samples were taken and studied to determine rates of wear. All the cars were fueled with commercial premium gasoline, but half were lubricated with a fully compounded low alkalinity oil, the others with a higher alkalinity oil. There was very little difference in wear rates with the two oils. It was found that approximately 50% of the wear found in the test vehicles was due to oil-borne abrasion, 45% to low temperature corrosion, and 5% to other causes. "Why Does Your Car Wear Out," by H. R. Jackson, Atlantic Refining Co. (2000 words, 4 charts); annual meeting, Society of Automotive Engineers, Detroit, Jan. 14-18, 1957.

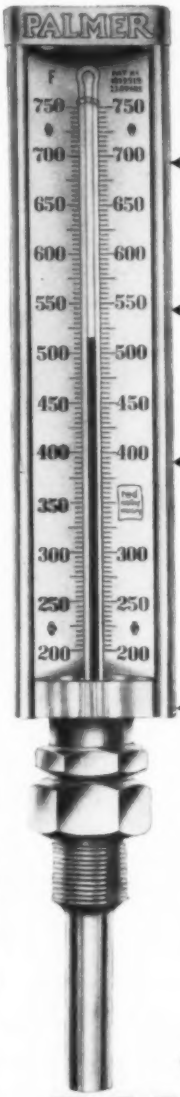
For More Information

. . . on papers discussed above, write to Society of Automotive Engineers, 29 West 39th Street, New York City, N. Y.

Today's Modern Industry
Demands a Modern Thermometer

PALMER

RED-READING MERCURY THERMOMETERS



Red-Reading Mercury

Extruded Brass Case

Chrome Finish

Ranges −40 to 950°F or Equivalent in °C

Write for Complete Information

Ask for Bulletin No. 35

Consult your Classified Directory

PALMER

THERMOMETERS, INC.

Mfrs. of Industrial Laboratory, Recording and Dial Thermometers

Cincinnati 12, O.

Combustible Vapors

What Are They: Combustible vapors are gaseous mixtures of flammable materials. They will burn rapidly under right conditions, frequently with explosive force.

Flammable liquids do not actually burn; it is their vapors which burn in the air. However, the term *flammable liquid* has come to mean any fluid that will vaporize to form a potentially explosive mixture with air.

Conditions Needed for Combustion: There are four physical conditions that must be present before a material will burn. They are:

A combustible vapor—one that will combine with oxygen, unlike inert neon or argon gases.

Oxygen—or an atmosphere containing a proportion of oxygen, such as the 20% oxygen content of air.

Ignition temperature—a sufficient heat to initiate combustion, and

The right proportion of combustible vapor and air.

When all four of these conditions are present the initial ignition will spread rapidly throughout the entire vapor-air mixture.

Another condition helps create the right setting for a vapor explosion—flash point. Because most materials do not burn unless they are in a vapor or gaseous form, it is essential that sufficient vapor from a liquid is driven off and mixed with air before the material will burn.

The temperature at which sufficient vapor to form an explosive mixture is driven off from a liquid is called the *flash point*. This term applies mostly to liquids, although there are certain solids (such as camphor and napthalene) that slowly evaporate and have a flash point while still in the solid state. For gases, of course, there is no specified flash point.

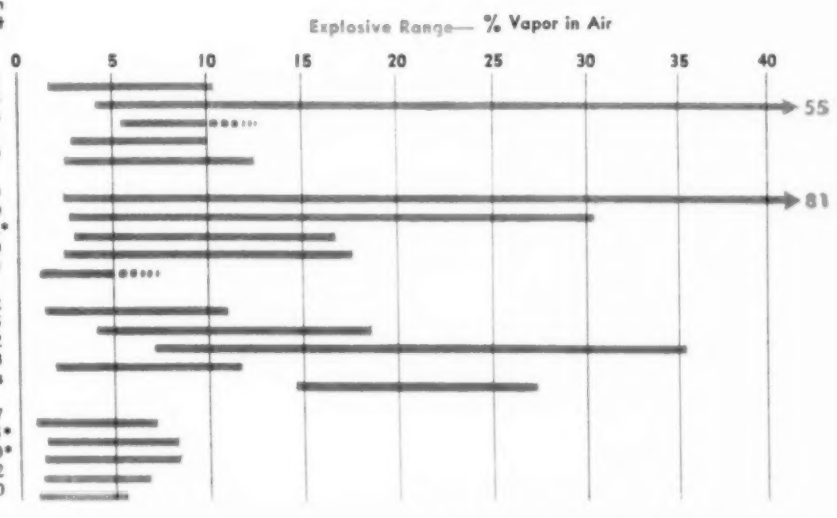
The flash point commonly referred to is the *closed cup* point, which derives its name from a method of testing specified in ASTM D 56 or D 93. However, for certain materials with higher flash temperatures, an open cup flash point is usually determined by ASTM D 92.

Explosive Range: Combustible vapors, once ignited, will not continue to burn unless the right proportion of vapor and air is present. If the vapor particles are so widely separated that those initially set on fire will not ignite others nearest them, the mixture is called too "lean" and will not burn. If the vapor particles are so close together that they exclude the oxygen necessary for combustion, the mixture is called too "rich" and likewise will not burn.

The lowest concentration of flammable vapor in air that is capable of transmitting flame throughout the entire mixture is called the Lower Explosive Limit (L.E.L.) The highest concentration of vapor that will burn is called the Upper Explosive Limit (U.E.L.) Between these two is the explosive range of a combustible vapor.

Table of Explosive Ranges of Combustible Vapors

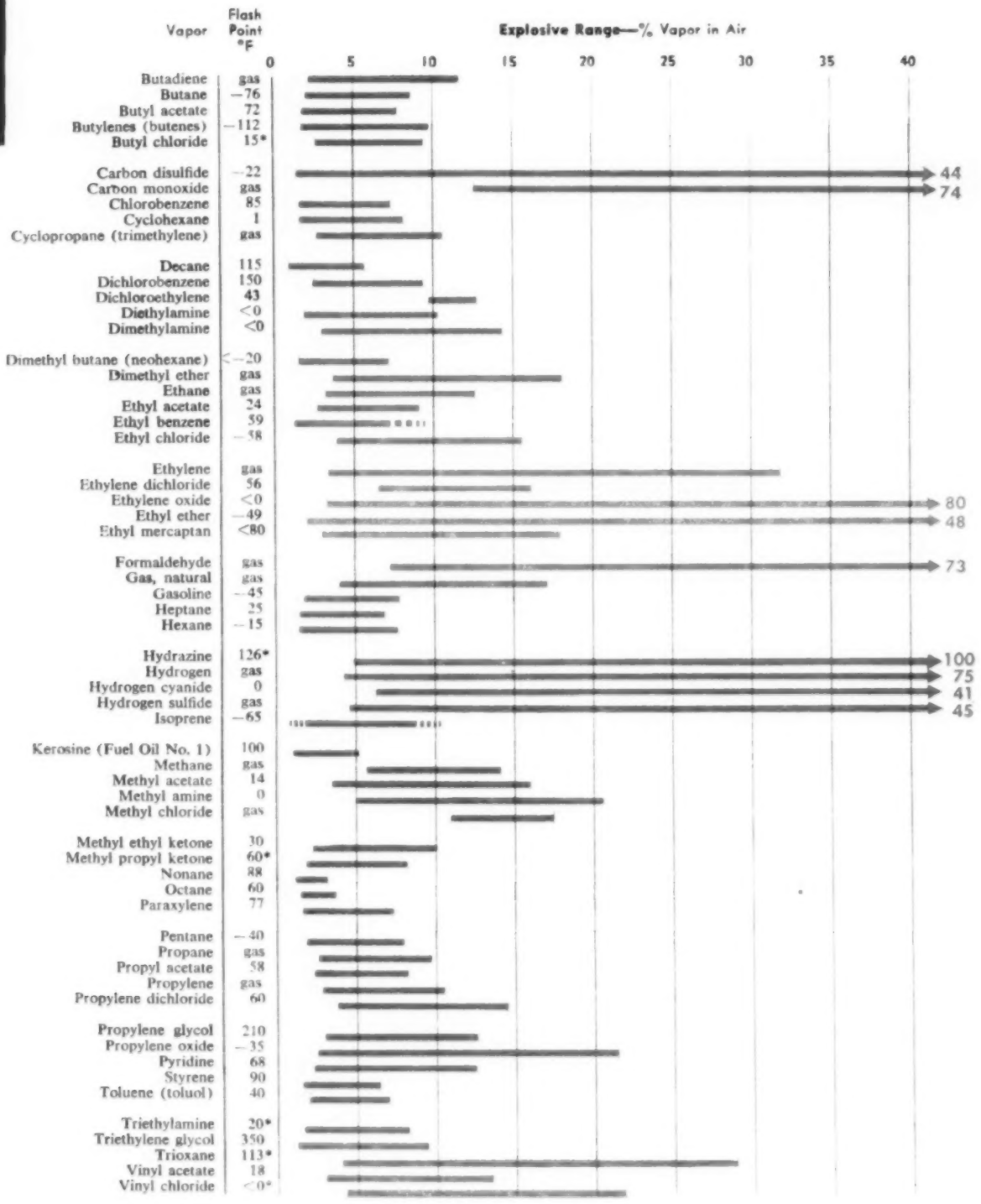
Vapor	Flash Point °F
Acetal	−5
Acetaldehyde	−36
Acetic acid	104
Acetic anhydride	121
Acetone	0
Acetylene	0
Acrolein	<0
Acrylonitrile	32*
Alcohol - Allyl	70
Amyl	100
Butyl	82
Ethyl	55
Methyl	52
Propyl	53
Ammonia (anhydrous)	gas
Amyl acetate	77
Amyl chloride	55*
Amylene	0*
Benzene (benzol)	12
Benzine (petroleum ether)	<0



*Open cup test

Table Continued on Next Page . . .

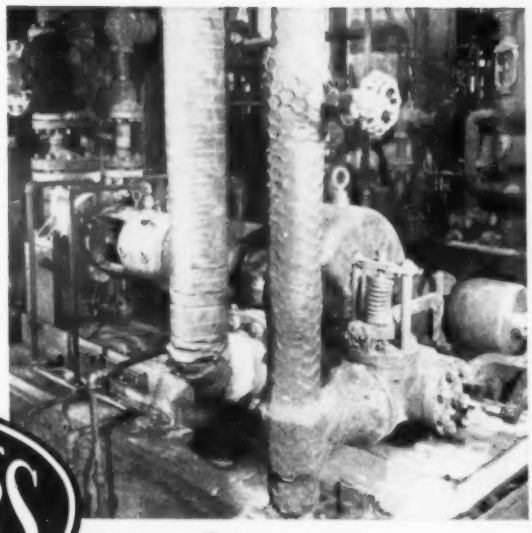
Table of Explosive Ranges (continued)



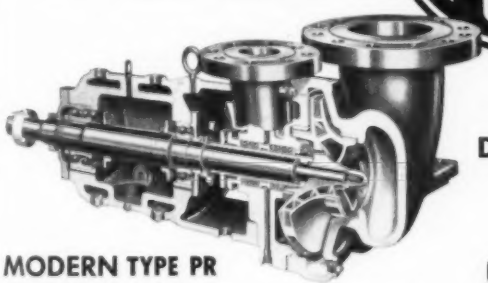
*Open cup test

GET THE Modern Design OF PEERLESS PUMPS...

FOR *Dependable Pumping* OF REFINERY PROCESS LIQUIDS

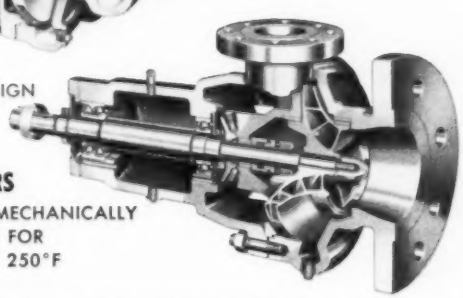


PEERLESS PUMPS



Modern TOP AND END SUCTION *and* TOP DISCHARGE DESIGNS IN BOTH TYPES FOR CONTINUOUS DUTY SERVICE IN MODERN REFINING PROCESSES

MODERN TYPE PR
CENTER-LINE MOUNT PACKING GLAND PUMP DESIGN FOR TEMPERATURES UP TO 850°F



MODERN TYPE PRS
CENTER-LINE MOUNT MECHANICALLY SEALED PUMP DESIGN FOR TEMPERATURES UP TO 250°F

USE THE HORIZONTAL TYPE PR PUMP WHERE YOUR APPLICATION REQUIREMENTS ARE: Rugged Center-Line-Mount Construction; High Temperatures; High Pressures; High Capacity; Extra Low NPSH Requirements; Optional Use of Mechanical Shaft Seal or Packing Gland Construction; End or Top Suction Design; Dependable Performance with Minimum Maintenance; Availability in Various Alloys; A Complete Range of Sizes; Many Sizes Available from Stock in Standard Materials; Maximum Parts Interchangeability; Wide Range of Liquid Pumping Services, such as Hot Oil, Butane, Propane, Hydrocarbons, Hard-to-Handle Chemicals and Water. For descriptive Bulletin check and mail coupon.

TYPE PR PUMPS ARE A LINE OF PACKING GLAND AND MECHANICALLY SEALED PROCESS PUMPS with these Specifications—

Capacities: up to 12,000 gpm.

Operating Heads: up to 675 feet.

Temperatures: Type PR (Packing gland construction) up to 850°F; Type PRS (Mechanical Shaft Seal Construction) up to 250°F.

Case Pressures: up to 600 psi.

Drives: horizontal electric motor is standard; others as required, such as steam turbine drive or stationary engine drive.

Materials of Construction: Liquid end can be furnished in cast iron, bronze, carbon steel, stainless steel or other materials as required for intended service.

Liquids Handled: hot oil, hot water, propane, butane and all petroleum hydrocarbons, process liquids, Dowtherm, and numerous other solutions.

NPSH Characteristics: designed to operate with minimum available NPSH.

PEERLESS PUMPS

PEERLESS PUMP DIVISION
FOOD MACHINERY AND CHEMICAL CORPORATION

Factories: Los Angeles, Calif. and Indianapolis, Indiana.
Offices: New York, Atlanta, Chicago, San Francisco, St. Louis, Phoenix, Fresno, Los Angeles; Plainview and Lubbock, Texas; Albuquerque, New Mexico.
Distributors in Principal Cities; Consult your Telephone Directory.

fmc

MAIL COUPON FOR BULLETIN

PEERLESS PUMP DIVISION
Food Machinery and Chemical Corporation
301 West Avenue 26
Los Angeles 31, California

Please send us copy of Peerless Type PR Pump Bulletin No. B-1605.

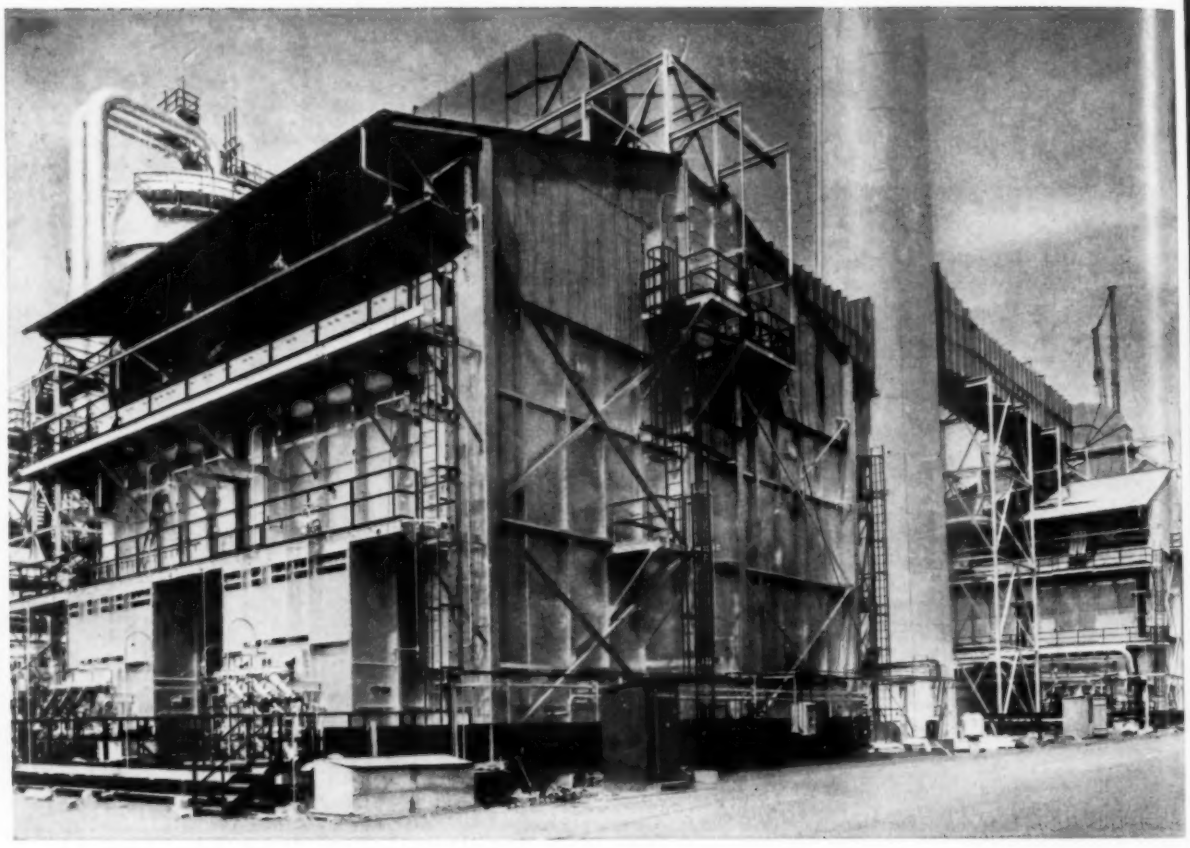
NAME_____

COMPANY_____

STREET_____

CITY_____ STATE_____

PP



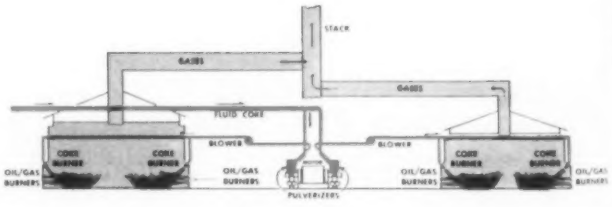
357,000,000 btu/hr

from two FW direct-fired oil heaters designed to burn FLUID COKE

SUPPLYING the heat requirements of the world's highest capacity crude distillation unit at the new ultra-modern Delaware Flying A Refinery of Tidewater Oil Company, the two Foster Wheeler direct-fired oil heaters shown above have a heat absorption capacity of 357 million btu per hr. The petroleum industry's first direct-fired heaters designed to burn fluid coke, they are capable of heating 130,000 bbl of crude per day.

Fluid coke can be burned at the rate of approximately 220 tons per day, supplying one half of the total direct heat requirements when operating at full capacity. Fuel oil or gas burning will supply the other half.

This installation is another example of Foster Wheeler's ability to design and construct direct-fired heaters of exceptionally high heat-duty requirements. This specialized



experience can help you save time and expense in meeting your exact requirements for special heating and vaporization units. For full details on the 357,000,000 btu/hr units above, send for the Nov.-Dec. Heat Engineering. *Foster Wheeler Corporation, 165 Broadway, New York 6, N.Y.*

FOSTER WHEELER

NEW YORK • LONDON • PARIS • ST. CATHARINES, ONT.

PERSONALS

Mr. Mangelsdorf

Mr. Copeland

Mr. Bailey

Texaco Promotes Three in Refining

IN A series of top level changes announced by The Texas Co., **T. A. Mangelsdorf,** general manager of the refining department, was elevated to vice-president. In his new post, Mangelsdorf will carry out special assignments for the chairman of the Texaco board of directors.

William G. Copeland has been appointed general manager of the refining department. He was previously manager of the department's operations division. This post has been given to **Douglas P. Bailey,** who was assistant works manager of the Port Arthur refinery.

Mangelsdorf holds B.S. and M.S. degrees from M.I.T. and was later a member of the faculty. For Texaco he has served as superintendent of the Port Arthur and Lockport refineries, and as manager of the refining department's operations division.

Copeland was graduated from Rice Institute in 1927 with a B.S. in chemical engineering. He has served as assistant superintendent of the Lawrenceville, Ill., plant and as superintendent of the Sunburst, Mont., and Westville, N.J., refineries. He was made general superintendent at Port Arthur in 1954, where he served until his transfer to the operations division in New York in 1956.

A 1922 graduate of the University of Texas, Bailey has worked at Texaco as assistant superintendent of the West Tulsa, Okla., refinery and was refinery superintendent of a French subsidiary plant. He was general superintendent at Port Arthur and named assistant works manager there in 1945.

Fred Holloway has been transferred to Esso Standard Oil Co.'s New York office as assistant manager of the manufacturing department. His move followed the dissolution of the East Coast manufacturing division in the company, of which Holloway was manager. In eliminating this middle level of management, greater responsibility is expected to devolve on individual plant management.

The change has brought a new title to **Ross Murrell.** He was general superintendent of the Bayway refinery and now takes the new title of refinery manager.

At the Bayonne refinery, general superintendent **Dave F. Edwards** becomes refinery manager, also as a result of the reorganization.

At the Bayway refinery, **Douglas Bates** has been made head of the chemical products department. This unit plus the petroleum products department have replaced the process department. **Randy Wilkinson** has been named head of the petroleum products department.

Cape Harney has become the plant's employe relations manager.

Hugh Miller has joined Kerr-McGee Oil Industries, Inc., as manager of the Wynnewood, Okla., refinery. Miller was formerly president of the Corpus Christi Refining Co. and for 17 years general superintendent of refineries for Phillips Petroleum Co.

N. C. Kymes is now superintendent of the Fittstown, Okla., natural gasoline plant of Kerr-McGee. He succeeds Fred Fox, who resigned to accept a position at Kendrick, Okla.

Kenneth Smith will fill Kyme's former post as field superintendent of the Milfay, Okla., plant.

Odell Campbell, formerly manager of laboratories for Du Pont Co. in Tulsa, has joined Kerr-McGee in Oklahoma City as technical assistant to the vice-president of refining, R. M. Chesney.

C. L. Parris has been named manager of the new midwest plant of Amoco Chemical Corp. He was chief engineer of the El Dorado refinery of American Oil Co. Not yet built, the plant will produce aromatic acids from petroleum raw materials.

Parris joined the engineering department of Standard Oil Co. (Ind.) in 1942, became supervisor of the department in 1947, and transferred to Amoco at El Dorado three years later.

He holds civil engineering degrees from Texas Technological College and Illinois Institute of Technology.

Dan Milsom has been transferred to Cities Service Research and Development Co.'s product research lab at Cranbury, N.J. He was on special assignment at Brookhaven Laboratory of the Atomic Energy Commission. Administratively Milsom has been part of the Lake Charles, La., lab. He will be in charge of radiation research at Cranbury.

Edmund Field has been elevated to senior research associate at the Whiting, Ind., laboratories of Standard Oil Co. (Ind.) He will coordinate work on olefin polymerization related to high polymers. He holds degrees from Illinois Institute of Technology and Northwestern University.

Dr. Field

Dr. Herbert N. Friedlander has been named group leader at the laboratories. He did his undergraduate and graduate work at the University of Chicago.

Henry C. Oliver has been promoted to group leader in the technical service department at Whiting. He will work in the refinery economics division on crude oil evaluation and naphtha reforming problems. He is a graduate of Purdue University.

Edward Oliphant, Jr., has become a group leader at the Sugar Creek,

New JERGUSON Gage Illuminator

gives up to 3 times the illumination

lights entire gage glass

no glare or blind spots

low cost lighting

explosion-proof

UL approved

new, one-twist lamp replacing

Easily mounted on back of Transparent Gage.

The New Jerguson EPL-56 Illuminator gives three times the illumination (and 3 times the bulb life) . . . a bright, evenly diffused light over the entire length of gage glass, thus enabling you to see the liquid level clearly and easily under all conditions. Relamping is simplified: one turn of the thumb screw and you lift out cover and bezel in one piece.

Jerguson Illuminators incorporate the principle of solid wedge lighting. Illumination from a single bulb is reflected from the angular surface of the plastic wedge and is evenly diffused through the transparent gage glass.

Jerguson Illuminators are UL approved and are built in accordance with their Standard for Electric Lighting Fixtures for use in hazardous locations for Class 1, Group D Services. They are made in a variety of sizes.

Write for Data Unit on Process Gage Illuminators.

JERGUSON

Gages and Valves for the Observation of Liquids and Levels

JERGUSON GAGE & VALVE COMPANY
100 Adams Street, Burlington, Mass.
Offices in Major Cities
Jerguson Tress Gage & Valve Co., Ltd., London, Eng.
Pétrole Service, Paris, France

Mo., research department laboratory. He is a graduate of the Missouri School of Mines, with a B.S. in chemical engineering.

Dr. Kasch

Mr. Peeler

Dr. John E. Kasch has joined the board of directors and been appointed a vice-president of American Oil Co. He remains in the company's New York offices and his job will be to coordinate the activities of several staff departments.

Winston S. Peeler has been promoted to general manager of manufacturing, succeeding **Roy J. Diwoky** who resigned to join Commonwealth Oil Refining Co. Peeler was general superintendent in the administrative department of the Texas City refinery. In his new post he moves to New York.

William J. Abnett has been named an assistant project engineer in Sun Oil Co.'s manufacturing department. His duties will concern plant construction supervision. Previously he served as assistant technical adviser on natural gas and gasoline projects in Sun's production department.

Dr. William Claussen has been appointed vice-chairman of the West Coast Section of the Air Pollution Control Association. Claussen is executive secretary of the American Petroleum Institute's Smoke and Fumes Committee.

John T. McCoy has been named chairman of Tidewater Oil Co.'s new supply and distribution committee. The unit will coordinate crude supply, product distribution, and inventories and will make recommendations to the divisional operating committee. McCoy was formerly manufacturing department coordinator representing the Delaware City refinery at divisional headquarters in New York.

Eight supervisors have been assigned to jobs at Tidewater Oil Co.'s Delaware City refinery.

Raymond K. Arzinger has been appointed technical foreman of the utilities and sulfur recovery area. He became an assistant engineer in 1955.

Charles H. Bennett has been named technical foreman of the cracking area. He was previously assistant process engineer at Bayonne.

William W. Burleigh has been appointed technical foreman of the desulfurizing and hydrogen area.

William J. Doyle, Jr., has been named technical foreman of the crude area.

Laurance A. Gleason has been appointed technical foreman of the alkylation polymerization area. He was last coordinator of the eastern division lubricants supply department.

Edwin J. Hoffman has been named technical foreman of the coking area. He was made a group leader at Bayonne in 1953.

Glenn W. Wimberly has become technical foreman of the reforming and extraction area. He became a combustion engineer at Bayonne in 1954.

R. E. Lumpkin has been appointed a general coordinator. He was last an engineer with The Texas Co. and prior to that a field engineer with M. W. Kellogg Co.

Roy J. Diwoky has been named president of Commonwealth Oil & Refining Co., with headquarters in Ponce, Puerto Rico.He was formerly a director and general manager of manufacturing for American Oil Co.

Mr. Diwoky

A graduate of the University of Iowa, Diwoky entered the oil industry in 1935 as a research engineer for Standard Oil Co. (Ind.) He moved to manufacturing in 1940 and eventually became assistant superintendent of the Whiting refinery. In 1949 he went to New Orleans as board member and assistant to the president of Pan-Am Southern Corp. He became executive vice-president of that company in 1951 and in 1956 was made general manager of manufacturing and a director of American Oil.

R. R. Dean has been promoted to senior vice-president in charge of manufacturing and marketing for Tennessee Gas Transmission Co. He was formerly a vice-president, and is president of Bay Petroleum Corp., refining and marketing subsidiary of TGT.

(To obtain more data on advertised products see page 170)

J-M 85% Magnesia is lightweight . . . easy for workmen to install half-sections on this 10" steam line. Insulation work at the Grace Chemical plant was performed by Young Sales Corporation of St. Louis. Engineering and construction was directed by Foster Wheeler Corporation of New York.

Your Btu's and dollars go further when you specify **Johns-Manville 85% Magnesia**

. . . the choice of insulation engineers at Grace Chemical's new Memphis plant

INDUSTRY'S LONG-TIME standard for temperatures to 600F is still your best insulation buy. For J-M 85% Magnesia provides high insulating value, easy application, long life, initial low cost and minimum maintenance. That's why insulation engineers consistently specify J-M 85% Magnesia for modern installations like Grace Chemical's new anhydrous ammonia-urea plant. That's why it will pay you to specify J-M 85% Magnesia for your new plant or modernization program.

To assure you maximum value from your insulation dollar, Johns-Manville gives you complete drawing-board-to-job-site service. You get expert recommendations by the world's most experienced insulation engineers . . . plus expert installation by authorized J-M Insulation Contractors. Write today for further information on J-M 85% Magnesia and Johns-Manville's unmatched facilities to solve your insulation problems. Address Johns-Manville Box 14, New York 16, N.Y. In Canada, Port Credit, Ontario.

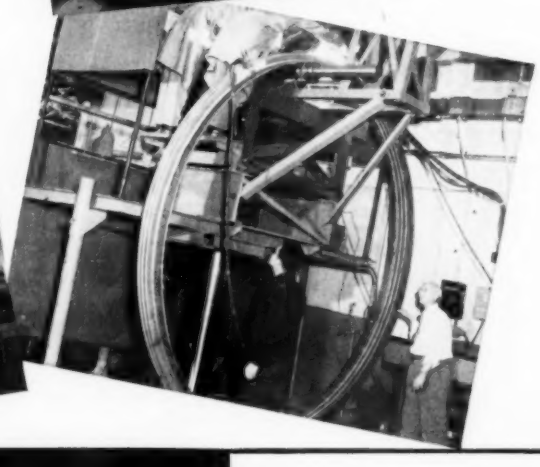
J-M 85% Magnesia also comes in block form. Here you see it being applied to a vertical drum at a New Jersey petroleum refinery.

JOHNS-MANVILLE JM PRODUCTS

Johns-Manville *first-in* INSULATION

MATERIALS · ENGINEERING · APPLICATION

(To obtain more data on advertised products see page 170)



Highest quality expansion joints

Quality is built into every Sola-Flex joint. From extensive research and development programs through to precision fabrication, every step guarantees an extra measure of durability and trouble-free service. And Sola-Flex joints are economical—in initial cost and in long life. Send for a Sola-Flex catalog. Dept. C-132, Solar Aircraft Co. San Diego 12, Calif.

SOLAR
SOLA-FLEX®
EXPANSION JOINTS AND BELLOWS

SOLAR
AIRCRAFT COMPANY
SOLAR
SAN DIEGO DES MOINES

Mr. Moody

Mr. Swanson

Mr. Erickson

UOP adds new service, expands PC sales

UNIVERSAL Oil Products Co. has expanded services to the oil industry in two areas:

1—It has formed a market research and economics department to help refiners with problems of plant expansion, modernization and new building.

2—It has enlarged the petrochemical process sales department by the addition of three new members.

The new research department will be headed by Samuel W. Curry, petroleum economics specialist with six years' experience in UOP sales and marketing posts. The new group pulls together in an integrated department the company's previous activities in market research.

Functions include marketing studies of projected demand for any refinery product, analysis of economic potential of processes and equipment, and estimates of future price and production trends. The group will also make financial studies of existing plants—useful for the refiners who require outside financing for expansion programs.

The service is intended to provide up-to-date economic evaluations for the small refiners who cannot afford to staff their own businesses with economists.

The increasing interest in petrochemicals on the part of refiners has brought the need to expand UOP's staff. Duties of the new men will include economic studies of specific refinery operations to evaluate the commercial application of petrochemical processes, and the sale and licensing of processes to industry. The new men are as follows:

Raymond A. Erickson, formerly engineering economics supervisor at Armour Research Foundation, in Chicago, is a University of Wisconsin graduate in chemical engineering. He also has been associated with Great Lakes Carbon Corp.; Ebasco Services; Southern California Gas Co.; and Standard Oil Co. of California.

Robert A. Moody holds a master's degree in chemistry from the University of Michigan. He has been with Humble Oil Co. and was a chemistry teacher at the Annapolis Naval Academy.

William M. Swanson, who holds a bachelor's in chemical engineering from Purdue University, joined UOP in 1953 and has been in the service department.

Houdry moves Hornaday to R&D

Houdry Process Corp. has promoted George F. Hornaday to associate manager of research and development, succeeding T. A. Burtis, who was recently elected president and board chairman. Mr. Hornaday was assistant manager of process sales and has been replaced by D. Eugene Norris.

Mr. Hornaday moves from the Philadelphia headquarters to the firm's laboratories at Linwood, Pa. He holds a B.S. in chemical engineering from Purdue University. He joined the company in 1940 as assistant manager of development and worked on the company's dehydrogenation unit during World War II. In 1952 he joined the commercial development department, and he was made assistant manager of process sales early in 1956.

Mr. Norris is a graduate of the University of Pittsburgh in chemical engineering. He worked with Socony Mobil Oil Co. on refineries started up during World War II. He has worked in the technical service division with Houdry, the process section of the engineering department, and the commercial development and process sales departments.

B&W assigns v-p to boiler sales

S. T. Mackenzie has been elected a vice-president of the Babcock & Wilcox Co. and placed in charge of the boiler division's sales department. He was formerly sales manager of the department and succeeds W. T. McCullough, Jr., who has retired.

Mr. Mackenzie was graduated from Lehigh University in 1924 and joined B&W as a sales engineer in Philadelphia in 1934. He became district manager of the office in 1947 and sales manager of the division in 1951.

Graver names sales manager

Vincent J. Calise has been appointed general sales manager of Graver Water Conditioning Co., a division of Graver Tank and Manufacturing Co. He holds both chemical engineering and mechanical engineering degrees and has spent 17 years in the field of water and waste treatment.

Mr. Calise

Mr. Calise has been prominently associated with many developments and applications in the field, including demineralization for power plant and process water treatment, hot process treatment, clarification and softening of hard and turbid water supplies, and the application of ion exchange to plating and waste problems.

Vogt names new president

Henry V. Heuser, grandson of the founder, has taken over the presidency of the Henry Vogt Machine Co. Mr. Heuser succeeds his father, G. A. Heuser, who becomes chairman of the board. The new president is a graduate chemical engineer from Purdue Uni-

Are you going to let this happen to YOU?

We think it is smarter to play safe all the time
Observe every safety rule and use

Swagelok®
FITTINGS

GET ALL THE FACTS: Write for the Swagelok catalog. Address Dept. D3

CRAWFORD FITTING CO.
884 EAST 140th STREET
CLEVELAND 10, OHIO

versity and has worked in every department of the company during the past 20 years.

The Vogt firm, located in Louisville, Ky., makes forged steel valves and fittings, steam generators, and other refinery and chemical plant equipment.

SD Plants appoints gen'l manager

Dwight A. Dougherty has been made general manager of SD Plants, Inc., construction subsidiary of Scientific Design Co. He joins the company after 25 years with M. W. Kellogg Co. He was last Kellogg's assistant director of construction and manager of the Canadian and Latin American operations.

Mr. Dougherty

Mr. Dougherty was educated at De Pauw University and the University of Arkansas.

Personnel Changes

Warner Lewis Co.—Milton A. Phillips to representative for the eastern U.S. He was assistant sales manager in Tulsa.

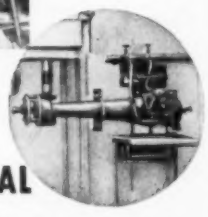
Fluor Corp.—J. L. Tathwell, chief project engineer, and F. G. Crawford, manager of project coordination, have been each given title of manager of projects, new posts created to strengthen direction of Fluor projects. Their old titles have been discontinued.

Babcock & Wilcox—Claude L. Huey to manager of the Atlanta district sales of the boiler division; Paul M. Brister to manager, engineering design section, of the manufacturing engineering department in the boiler division. He is active in subcommittees of the ASME boiler and pressure vessel committee and is chairman of the steam power panel of the joint ASTM-ASME committee on the effects of temperature on properties of metals.

Branches, Distributors

Howe-Baker Corp. has opened an eastern division office at 35 Leonard Dr., Westwood, N.J. Office will supply engineering services for firm's electrical desalting and distillate-treating processes. Manager is Frank A. Lee, who was previously with Humble Oil & Refining Co. and Petro-Chem Development Co.

VERTICAL



OR
HORIZONTAL

many more hours on stream without forced shutdown with NATIONAL AIROIL

OIL-GAS TANDEM COMBUSTION UNITS

Exclusively for vertical firing, the new National Airoil VERTICAL Tandem Block Units retain all the features of our regular horizontal Tandem Units . . . *plus:* special, pre-cast refractory shapes for easier, cost-saving vertical installation and maintenance; secondary air inlet louvres for positive control of vertical flame pattern; and, all steel duplex detaching gear which enables swift, simple vertical burner changeover.

VERTICAL and HORIZONTAL Tandem Units hold air in the combustion zone until fuel and heated air are thoroughly mixed. This means that ignition takes place in a hot zone; the result: high fuel economy through more rapid combustion with a minimum of excess air. NATIONAL AIROIL's patented Tandem Combustion Units allow secondary air to be easily and accurately controlled. By adjusting air control louvres, flame can be shaped to radiate heat uniformly without tube impingement.

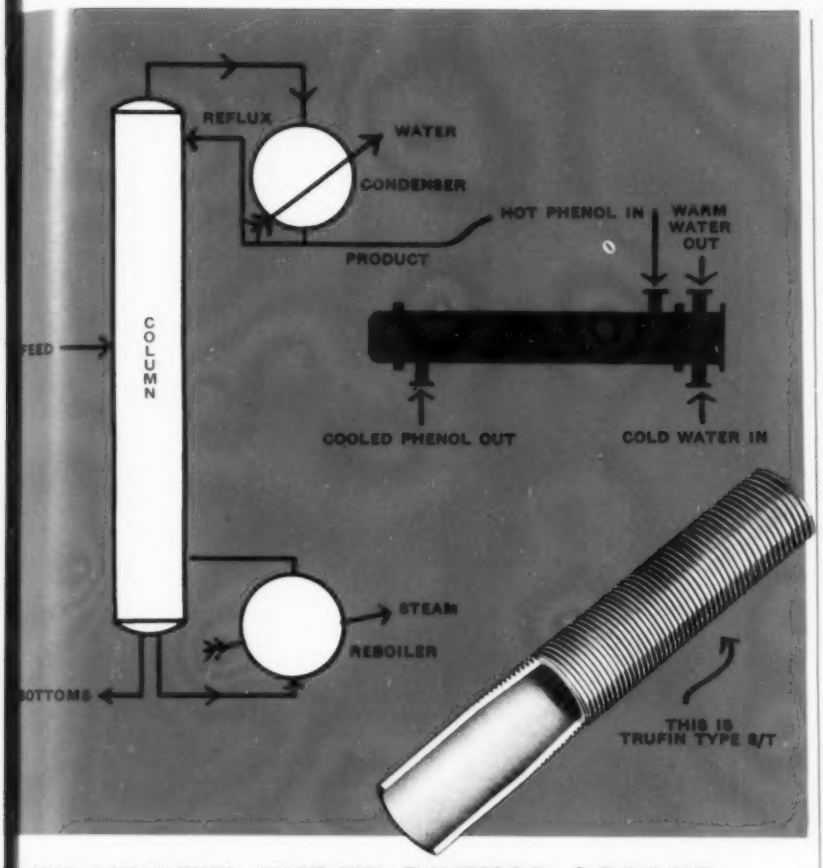
The VERTICAL or HORIZONTAL Tandem Unit is always fired with NATIONAL AIROIL Combination Oil and Gas Burners . . . has a high turndown ratio with a steady flame temperature using either fuel oil or gas. With the TANDEM UNIT'S clean flame, a cold furnace can be brought to full capacity in a short time.

"Many, many more hours on stream, without shutdown" . . . yes, YOU will realize higher profits from YOUR heaters when NATIONAL AIROIL VERTICAL or HORIZONTAL Tandem Units are specified. Our new Bulletin 498 is yours for the asking.

CHEMICAL-PETROLEUM DIVISION

NATIONAL AIROIL BURNER CO., INC.

1297 EAST SEDGLEY AVE., PHILA. 34, PA.
Southwestern Division
2512 South Boulevard, Houston 6, Texas
INDUSTRIAL OIL BURNERS, GAS BURNERS, AND FURNACE EQUIPMENT



ONE TRUFIN-TUBED PHENOL COOLER REPLACES TWO PLAIN TUBE EXCHANGERS

By Ernest Dodd

Down near Louisiana's gulf coast, processing engineers at a large refinery are currently engaged in some highly interesting experiments in the field of heat transfer.

To put it bluntly, the objective of their research is to compare the performance of Wolverine Trufin® Type S/T against that of prime surface condenser tube. The results to date are proving conclusively that Trufin Type S/T offers plus advantages impossible to obtain from plain tube.

In conducting their research, the engineers are using two coolers—one tubed with prime surface tube and the other with Wolverine Trufin Type S/T—the integrally finned condenser tube. The operation involved is the cooling of phenol with water on the tube side and the phenol being cooled on the shell side.

To obtain a comparison of performance everything is the same—except the surface of the tubes. The extended surface, Trufin-tubed unit has 860 pieces of Admiralty Trufin Type S/T ¾" O.D. by 16' in length. The prime surface unit also has 860 pieces of tube of the same O.D., alloy and length.

It is in heat transfer surface, however, that a startling difference becomes apparent. The prime surface unit has a total of 2,690 square feet. In the Trufin-tubed unit the total heat transfer surface soars to 6,050 square feet—an increase of 125% (or 225% of the surface of the plain tube unit).

The Trufin-tubed cooler has been on stream for the past eight months and is presently handling the entire heat load formerly handled by the two plain tube coolers. Its record, in fact, is so good that the refinery engineers have designed Trufin into several of their forthcoming expansions.

WRITE FOR FREE BOOK

Actual installations where Wolverine Trufin is being used throughout the processing industries are described in text and drawings in the "Wolverine Trufin Process Flowsheets" Book.

In addition, this handy book also contains information about Wolverine Tube, its facilities and the specialized engineering services it offers its customers.

Processing Engineers – both experienced veterans and those just starting their careers will want to add this source of finned tube information to their reference files.

The Trufin Process Flowsheets Book is yours without cost or obligation. Write for your copy today!

CAN SUBSTITUTE TRUFIN DIRECTLY FOR PLAIN TUBE

When retubing heat exchangers or condensers, no basic equipment changes are necessary where Wolverine Trufin takes the place of prime surface tube.

During the finning process the ends of the tube are left without fins and the tube is designed so that the O.D. of the plain end is slightly larger than the O.D. over the fins. As a result, Trufin can be inserted into the bundle and rolled directly into the tube sheet in the regular manner using standard tools and normal retubing techniques.

TRUFIN INCREASES ON STREAM TIME

When working for the first time with integrally finned condenser tube, designers sometimes assume that finned tubing should be used only in a clean service.

Nothing could be farther from the truth. The compilation of actual operating data and the results of extensive pilot plant research are proving, instead, that integrally finned Wolverine Trufin actually gives better service than plain tube over longer periods of time.

Comparison tests (such as that described at the left) show that when Trufin fouls, the buildup of scale follows the profile of the fins and tube instead of preferring the valleys between the fins. Because Trufin does not present a flat, unbroken surface, there is a strong tendency for the scale to fall away—thus preventing the buildup of an impervious layer.

Wolverine Trufin available in Canada through the Unifin Tube Company, London, Ontario.

CALUMET & HECLA, INC.
CALUMET DIVISION
WOLVERINE TUBE DIVISION
FOREST INDUSTRIES DIVISION
GOODMAN LUMBER COMPANY
CALUMET & HECLA OF CANADA LIMITED
CANADA VULCANIZER AND EQUIPMENT COMPANY LIMITED

WOLVERINE TUBE

Division of Calumet & Hecla, Inc.

1441 CENTRAL AVE., DETROIT 9, MICH.

Manufacturers of Quality Controlled Tubing and Extruded Aluminum Shapes

Plants in Detroit, Michigan, and Decatur, Alabama. Sales Offices in Principal Cities

EXPORT DEPT., 13 E. 40TH ST., NEW YORK 16, N.Y.

MODERN HEAT TRANSFER CALLS FOR

Take a good look at the heat transfer operations listed at the right. Each is another in the long list of applications where Wolverine Trufin—the integrally finned condenser tube—is boosting heat exchanger and condenser capacity by transferring more BTU's per foot of tube.

In recent months, this series of advertisements has described operations where Trufin has boosted capacity by as much as 70%. These are authenticated figures—proof indeed that Wolverine Trufin is the answer to modern heat transfer needs.

If you're looking for increased capacity, reduced heat transfer costs and better all-round performance, now is the time to investigate Wolverine Trufin. Send for your copy of Wolverine's new book "Comparative Heat Exchanger Costs" or let Wolverine's Field Engineering Service review your particular problem. Either way you'll be on the road to increased heat transfer efficiency.

- Asphalt heater
- Reboiler
- Atmospheric section
- Light hydrocarbon condenser
- After cooler
- Heater
- Nitrogen after cooler
- Propane condenser
- Debutanizer condenser
- Ammonia condenser
- Methyl chloride condenser
- Phenol cooler
- Ethyl chloride condenser
- Butylene condenser
- Freon condenser
- Toluene reboiler
- Iso butane condenser
- Cooler
- Oil to Oil
- Debutanizer reboiler
- Oil cooler
- Gas cooler
- Inter-cooler
- Kerosene cooler
- Oil heater
- Tank suction heater
- Stripper overhead condenser
- Amine reboiler
- Debutanizer bottoms cooler
- Alcohol cooler
- Lube oil cooler
- Lean oil—rich oil exchanger

CALUMET & HECLA, INC.
CALUMET DIVISION
WOLVERINE TUBE DIVISION
FOREST INDUSTRIES DIVISION
GOODMAN LUMBER COMPANY
CALUMET & HECLA OF CANADA LIMITED
CANADA VULCANIZER AND EQUIPMENT COMPANY LIMITED

WOLVERINE TUBE

Division of Calumet & Hecla, Inc.

1441 CENTRAL AVE., DETROIT 9, MICH.

Manufacturers of Quality Controlled Tubing and Extruded Aluminum Shapes

PLANTS IN DETROIT, MICHIGAN, AND DECATUR, ALABAMA. SALES OFFICES IN PRINCIPAL CITIE

EXPORT DEPARTMENT, 13 EAST 40TH STREET, NEW YORK 16, NEW YORK

In water conditioning...

the tough jobs

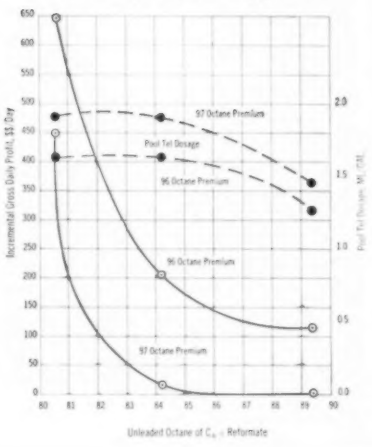
go to

W. H. & L. D. BETZ, Philadelphia, Pa.

TABLE I
Economic Study of Catalytic Reforming Operations

Reformer Operation	Design	Lo Level	Hi Level	Down
C_4+Product Clear Research Number	84.2	81.1	89.3	Jet Fuel
Pool TEL Dosage Ml./Gal. Premium Octane Level	1.625/1.895 96/97	1.65/1.92 96/97	1.275/1.44 96/97	2.685/2.97 96/97
Product Realization, $/CD	38880	39205	38625	30885
Variable Costs, $/CD				
96 Premium	2965	2850	2805	2965
97 Premium	3160	3045	2920	3125
Net Gross Realization, $/CD				
96 Premium	35915	36355	35820	27920
97 Premium	35720	36160	35705	27760
Incremental Gross Profit, $/CD				
96 Premium	210	650	115	
97 Premium	15	455	0	
Jet Fuel Break-Even with Best Performance Case, $/CD				
96 Premium—11.2c/Gal.				8435
97 Premium—11.1c/Gal.				8400

FIGURE 1
Economic Study of Catalytic Reforming Operations



A SMALL REFINER'S PROFIT GOES UP $400 PER DAY! Du Pont's economic study recently helped a progressive refiner realize optimum performance with a newly installed catalytic reformer. Three operating conditions were compared—low-level, design, and high-level severity. Two premium gasoline octane levels, as well as jet fuel production, were considered. The above table and graph (right) pointed up the proper severity level for the refinery being studied.

These charts show how Du Pont helped a refiner

...get higher octane at lower cost

The demand for higher-octane fuels places new and increased importance on the question: How can those extra octane numbers be achieved at lowest cost?

This subject has often come up for consideration at Du Pont, especially during analyses of refinery operations and the effect of these operations on tetraethyl lead requirements.

A Du Pont service

As a result of the knowledge and experience gained in this way, our technologists have been able to help a number of refiners cut octane-improvement costs.

You can call on Du Pont to work with your own staff to develop more economical ways of boosting octane levels, or to confirm the findings of your group. Or you may prefer to have our technical representatives consider your facilities and make recommendations to fit your individual needs.

In any case you need only contact the nearest Petroleum Chemicals Division office listed at right.

SALES OFFICES

Chicago 3—8 So. Michigan Ave. ..... RAndolph 6-8630
Cleveland 15—25 Prospect Ave. ..... SUperior 1-1363
Houston 2—705 Bank of Commerce Bldg. CApitol 5-1151
Los Angeles 17—612 So. Flower St. ... MAdison 5-1691
New York 20—1270 Ave. of the Americas ..... COlumbus 5-2342
Philadelphia 2—3 Penn Center Plaza ... LOcust 8-3531
Pittsburgh 22—1 Gateway Center ..... ATlantic 1-2933
San Francisco 4—111 Sutter St. ..... EXbrook 2-6230
Seattle 3—4003 Aurora Ave. ..... MElrose 6977
Tulsa 1—1811 So. Baltimore Ave. ..... LUther 5-5578
In Canada—Du Pont Company of Canada (1956) Limited, Petroleum Chemicals, 85 Eglinton Ave. East, Toronto 12, Ontario ..... HUdson 1-6461
In Other Countries—Petroleum Chemicals Division, Export Sales, 7496 Nemours Bldg., Wilmington 98, Del., OLympia 4-5121, Ext. 2962

DU PONT
REG. U. S. PAT. OFF.
Better Things for Better Living
. . . through Chemistry

Petroleum Chemicals

E. I. DU PONT DE NEMOURS & CO. (INC.) · Petroleum Chemicals Division · Wilmington 98, Delaware

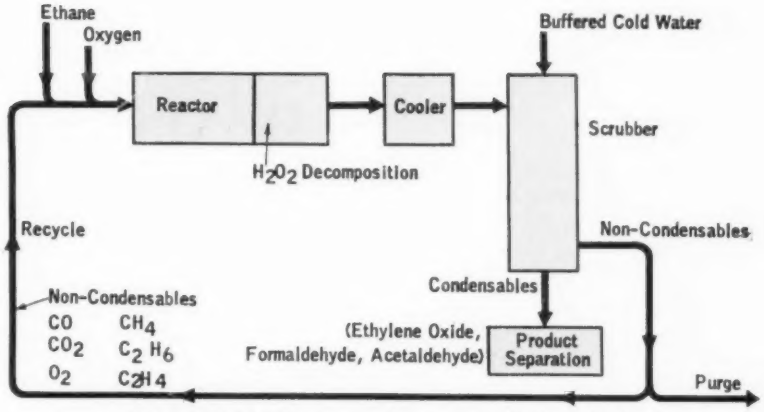
How do you rate In the patent race?

HOW DOES your company's patent ownership compare to your competition's? You can find the answer in a report recently published by the Senate Judiciary Subcommittee on Patents, Trademarks, Copyrights entitled, "Distribution of Patents Issued to Corporations."

Some 600 domestic and foreign concerns receiving U.S. patents are listed over the period 1939-1955, inclusive. Also shown in the report is the overall number of unexpired patents held at the end of 1955, plus a host of other statistical material.

Top industrial firm listed is General Electric (10,757 patents), followed by American Telephone & Telegraph (8,539), Radio Corp. of America (7,894), Westinghouse Electric Corp. (7,567), and Du Pont (6,338). A few of the petroleum and petrochemical companies in the listing are:

Ranking	Company Name	Patents Issued (1939-55)
5	Du Pont	6,338
6	Esso Standard Oil	4,899
10	American Cyanamid	2,872
12	Phillips Petroleum	2,424
13	Shell Oil Co.	2,374
19	Monsanto Chemical Co.	1,747
20	Socony Mobil Oil Co.	1,697
21	Universal Oil Products	1,665
22	Union Carbide	1,645
28	Standard Oil (Ind.)	1,393
31	Celanese Corp.	1,354
33	The Texas Co.	1,151
37	Imperial Chemical	1,030
51	Gulf Oil Corp.	770
70	Standard Oil (Calif.)	578
71	Union Oil Co. of Calif.	573
73	Sun Oil Co.	536
106	Pure Oil Co.	368
119	Standard Oil Co. (Ohio)	343
121	Houdry Process Corp.	342



NON-CATALYTIC process for direct oxidation of ethane

Ethylene Oxide from Ethane

A PROCESS for direct, non-catalytic oxidation of ethane to ethylene has been patented by National Research Corp., (U.S. Pat. 2,775,601).

As shown in the flow diagram, oxygen is mixed with a pre-mix of fresh ethane and ethane-rich recycle gas to give a C_2/O_2 molar ration of 10-15. Reaction is at 930-1300°F and 15-100 psig.

Effluent gases go to a hydrogen peroxide decomposer (inactive alumina), a cooler, and then a scrubber where condensables (ethylene oxide, formaldehyde, and acetaldehyde) are separated from non-condensables (part of which is purged, the remainder recycled to the reactor).

Yields for one test run, based on one pound of ethane consumed, were 0.38 lb ethylene oxide, 0.40 lb formaldehyde, and 0.09 lb acetaldehyde.

Better Asphalt for Road Program

TWO recent patents for better asphalts offer promise of better and cheaper paving asphalts.

Esso Research & Engrg. Co. (U.S. Pat. 2,776,933) claims a way to inject liquefied (instead of solid) ferric chloride prior to air blowing the asphalt, thus eliminating foaming and reducing the ferric chloride needed to give the same result.

Standard Oil Co. of Ohio (U.S. Pat. 2,776,932) reports improved temperature susceptibilities for air-blown asphalt by adding a heavy metal fluoborate catalyst before and/or after the air blowing step.

Shell wins TCP case

THE Patent Office has been overruled by a Federal Judge who ruled that Shell Development Co. and two of its research engineers are entitled to a patent on Shell gasoline with TCP (tricresyl phosphate). The Patent Office had refused to grant the patent, stating that TCP gasoline was an "oil composition" and not entitled to a patent.

The Federal Judge, Alexander Holtzoff, judge of the U.S. District Court for the District of Columbia, expressed the opinion that there seemed to be "no doubt that the inventors (Vernard Yust and John L. Bame, both on Shell's staff at Wood River, Ill.) in this case made an important discovery, namely, the ability to eliminate or at least substantially to reduce the fouling of spark plugs by the addition of the chemicals to gasoline fuels containing lead compounds."

Gasoline with TCP has been marketed since 1953. Shell states that 10-billion gallons of TCP gasoline have been sold in the United States in addition to many billions of gallons in other countries. It has received acceptance by the Air Force as well as other corporations and other countries.

HOW TO OBTAIN

greater throughput

IN SCRUBBING OPERATIONS

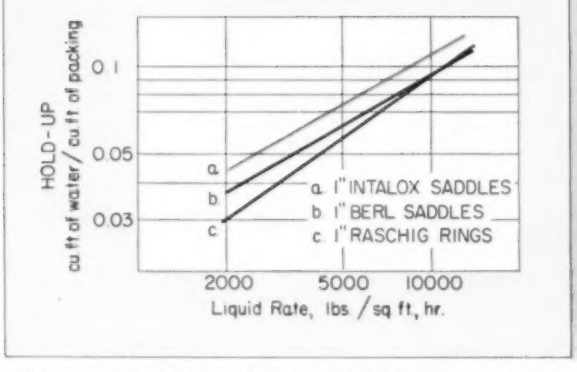
Greatest throughput in scrubbing operations is obtained at a balance point where maximum wetting of the packing occurs without flooding the tower. Maximum wetting involves a higher liquid hold-up.

Intalox saddles pack with greater randomness, form a loosely packed, yet tightly interlocked bed free from blocked areas, with higher surface area, and what is especially important, as far as throughput is concerned, provide a bed of greater and more uniform voidage.

As a result it is possible with Intalox saddles to have a higher liquid hold-up than with other packings yet still retain the low pressure drop characteristics of Intalox since the higher liquid hold-up results from a greater wetted-surface-area rather than from liquid-filled voids.

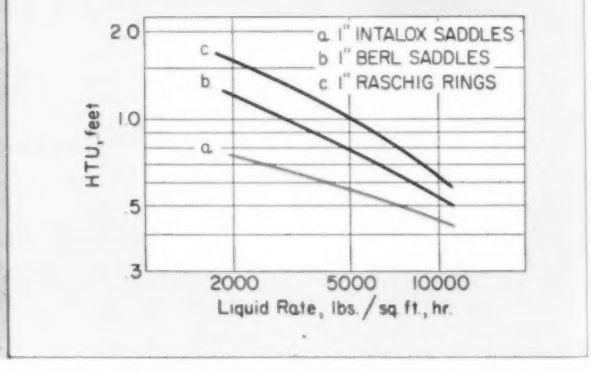
This ability to give higher liquid rates without flooding is reflected in substantially better mass transfer performance.

Fig. 1—HOLD-UP DATA



Higher liquid hold-up of Intalox Saddles reflects the better accessibility of the packing surface to liquid, thus greater wetted-surface area. Voids remain open, pressure drop low.

Fig. 2—HTU DATA



The capacity data shown are typical for a system where both gas and liquid film resistances are involved. Lower HTU values mean shorter towers, less pressure drop and reduced initial investments.

Write for this free booklet:

Bulletin S29-R gives full technical data on Intalox Saddles, performance charts, typical problems and solutions. Address: Dept. PP-357 U. S. Stoneware, Akron 9, Ohio.

U. S. STONEWARE

AKRON 9, OHIO

481-E

Patent law changes?

ALMOST a score of reports on the patent system either exist, or are being prepared for use in the Congressional hearings which are to be held later this year to study our country's patent laws and the way the laws are generally administered.

The first report was from Dr. Vannevar Bush, and contained a series of proposed changes designed to simplify the now-complex system to better serve the needs of inventors, businesses and consumers.

Another report by George E. Frost reviewed the patent system in terms of its function in today's economy, while still a third analyzed ownership of patents since 1939 (see "How Do You Rate In the Patent Race?" p. 153, this issue).

THE FOLLOWING PATENTS are selected from the Official Gazette of the U.S. Patent Office for Dec. 18, 25, Vol. 713, No. 3,4; and Jan. 1, 8, 15, Vol 714, No. 1,2,3. Copies of patents are available for 25¢ each. Order by patent number from the Commissioner of Patents, Washington, D.C.

Processes and Methods

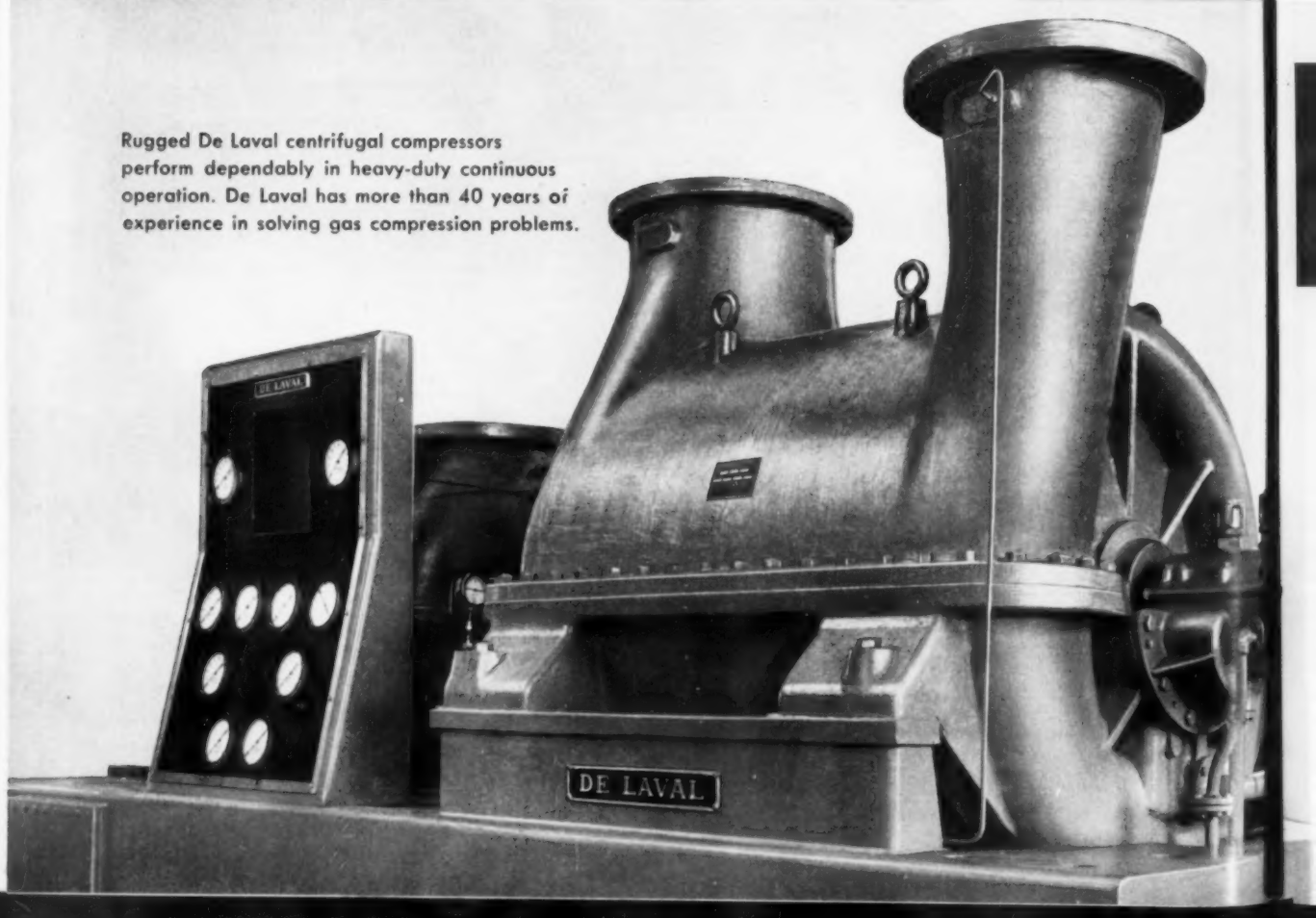
FOR . . .	OF . . .	WITH . . .	ASSIGNEE . . .	PATENT . . .
Alkylation	isoparaffins-olefins	liq. acid catalysts	Esso Research & Engrg. Co.	2,775,636
	toluene	monopropylating in para position	Union Oil Co. of Calif.	2,777,007
Catalytic reforming	naphthas	fluid., carbonized Mo-alumina cat.	Gulf Research & Development Co.	2,776,247
	naphthas	fluidized, platinum cat.	Standard Oil Co. (Ind.)	2,776,248
	naphthas	platinum or palladium cats.	M. W. Kellogg Co.	2,777,805
Coking	residual oils	coil & drum zone with fluid coke	Esso Research & Engrg. Co.	2,775,546
	residual oils	quench. & sep. of effluent vapor	Esso Research & Engrg. Co.	2,776,931
Contacting	immiscible liqs.	plurality of vertical stages	Esso Research & Engrg. Co.	2,776,329
Conversion	CH_4-sub.-naphthalenes	chromia-alumina cat.	Socony Mobil Oil Co., Inc.	2,774,801
	straight chain olefins	conversion to arom. hydrocarbons	Phillips Petroleum Co.	2,775,631
Dehalogenation	organic cmpds.	presence of detergent	M. W. Kellogg Co.	2,774,798
Dehydration	tar	super-atmospheric heating	Alfred Karl	2,775,541
Dehydrochlorination	benzene hexachloride	cat. of alkali (or alkaline earth metals) & halide	Ethyl Corp.	2,777,882
Demethanizing	hydrocarbons	demethanizer & solvent recovery	Phillips Petroleum Co.	2,775,103
Demethylation	toluene	non-catalytic heating process	Sun Oil Co.	2,776,326
Desulfurization	hydrocarbons	copper oxide slurry	Pure Oil Co.	2,776,246
Direct heating	pebble furnace	combustion gas & air stream	Phillips Petroleum Co.	2,776,825
Esterification	org. carboxylic acid	aromatic phosphoric acid cat.	Union Oil Co. of Calif.	2,776,985
Extraction	aromatics	H_2SO_4-dialkyl sulfate solvent	Socony Mobil Oil Co., Inc.	2,776,327
Fluid hydroforming	hydrocarbons	inverse temp. gradient	Esso Research & Engrg. Co.	2,777,803
Fractionation	crude oil	sep. of hi & lo-sulfur fractions	Gulf Research & Development Co.	2,776,250
Gasification	liq. fuels	combustion of part of the fuel	Koppers Co., Inc.	2,776,195
Hardening	fluid coke compactions	agglutinating carbonaceous binder	Esso Research & Engrg. Co.	2,776,935
Hydrofining	olefins	minimum hydrogen saturation	Hydrocarbon Research, Inc.	2,774,717-720
Hydrogenation	olefins	platinum-alumina magnesia cat.	Houdry Process Corp.	2,776,934
Hydrolization	aromatic sulfonic acids	continuous hydrolysis zone	Esso Research & Engrg. Co.	2,774,800
	isopropyl esters	acid from higher alc. hydrolysate	Shell Development Co.	2,776,324
	methylal	animal charcoal catalyst	Cities Service Oil Co.	2,776,318
Impregnation	celluosic fabrics	crease and shrink resistance	Shell Development Co.	2,774,691
Increase	cat. crack. stock	hydrodesulf & deasphalt gas oil	Esso Research & Engrg. Co.	2,775,544
Introduction	solid particles	pump in coal gasification	Esso Research & Engrg. Co.	2,774,635
Isomerization	xylenes	production of paraxylene	Esso Research & Engrg. Co.	2,775,628
Manufacture	acrylonitrile	cont. polymerization process	American Cyanamid Co.	2,777,832
	alkanes	phenol-aliphatic ketone react.	Shell Development Co.	2,775,620
	alumina cat.	low soda content	W. R. Grace & Co.	2,774,744
	aromatics	non-catalytic process	Esso Research & Engrg. Co.	2,775,629
	aromatics	reforming & extraction	Sun Oil Co.	2,775,632
	catalyst	platinum on alumina gel	Universal Oil Products Co.	2,774,743
	CO_2 hydrog. cat.	precipitated iron component	Ruhrchemie AG & Lurgi G.m.b.H.	2,777,823
	motor fuels	crude dist. & cat. cracking comb.	Esso Research & Engrg. Co.	2,777,801
	conversion cat.	platinum-alumina composition	Esso Research & Engrg. Co.	2,776,264
	cracking cat.	silica-alumina composition	Esso Research & Engrg. Co.	2,775,562
	cracking cat.	silica-alumina composition	W. R. Grace & Co.	2,777,822
	ethylene oxide	non-cat. vapor phase react.	National Research Corp.	2,775,601
	ethylene oxide	part. oxidation of ethylene	Chempatents, Inc.	2,777,862
	ethylene oxide & H_2O_2	non-catalytic process	National Research Corp.	2,775,510
	fluorohalocarbons	flourine-carbon react.	M. W. Kellogg Co.	2,774,197
	hexamethylene diamine	promoted cobalt oxide cat.	Du Pont Co.	2,776,315
	hydrazine	nitration of olefins	M. W. Kellogg Co.	2,776,190
	inorg. gel spheres	metal alcholate solution	Esso Research & Engrg. Co.	2,776,188
	maleic anhydride	part. oxidation of benzene	Chempatents, Inc.	2,777,860
	melamine	urea-melamine suspension	Monsanto Chemical Co.	2,776,284-6
	membrane	ion-exchange properties	Gulf Research & Development Co.	2,774,108
	moldable resin	aldehyde-amide condensation	Union Oil Co. of Calif.	2,775,571
	needle-like coke	special petroleum residuum	Great Lakes Carbon Corp.	2,775,549
	nickel catalysts	desulfurization properties	Wington-Abbott Corp.	2,776,244-5
	nitrogen fertilizer	uniform, moisture-stable grans.	Chemical Construction Corp.	2,774,660
	petroleum resins	improved color	Esso Research & Engrg. Co.	2,775,575-6
	phenyl dichlorosilane	C_6H_6-trichlorosilane-dichloro-silane	Union Carbide & Carbon Corp.	2,775,606

(Continued on p. 156)

Patents (continued)

FOR . . .	OF . . .	WITH . . .	ASSIGNEE . . .	PATENT . . .
Manufacture (Continued)	polymers	fluorine substituted ethylene	M. W. Kellogg Co.	2,774,751
	resin	air blowing of asphalt	Sinclair Refining Co.	2,774,724
	resinous mat'l.	metal alloys & dihalides	Sol B. Wiszer	2,775,563
	soluble oil	oxid. of extracted mineral oil	Standard Oil Co. (Ohio)	2,774,780
	spheroidal particles	chromia-alumina gel	Socony Mobil Oil Co., Inc.	2,774,742
	styrene oxide	monovinyl aromatic hydrocarbon	Dow Chemical Co.	2,776,982
	urea	react. of NH_3 & CD_2	Montecatini	2,777,877
	vinylidene fluoride	1,1-difluorchloroethane heating	M. W. Kellogg Co.	2,774,799
Operation	deethanizer	rich absorption oil introduction	Phillips Petroleum Co.	2,774,715
Oxidation	asphalt	$FeCl_3.6H_2O$	Esso Research & Engrg. Co.	2,776,933
	asphalt	metal fluoborate	Standard Oil Co. (Ohio)	2,776,932
	olefins	Cu phthalocyanine-derived cat.	Olin Mathieson Chemical Corp.	2,776,316
	waxy fractions	Mn & alkali metal cat. in situ	Sinclair Refining Co.	2,776,308
Partial Oxidation	hyrocarbons	presence of sulfur dioxide	Dresser Operations, Inc.	2,776,317
Polymerization	C_2-C_5 olefins	dehydrog.-polym. hydrog. system	Houdry Process Corp.	2,775,638
	ethenic groups	aqueous emulsion & cat.	Hercules Powder Co.	2,776,953-4
	isobutylenes	product having 10,000-20,000 M.W.	Esso Research & Engrg. Co.	2,775,577
	organic cmpds	organic peroxide & free radicals	United States of America	2,775,578
Preparation	cat. cracker feed	extract. dist. to remove metals	Esso Research & Engrg. Co.	2,777,802
Prevention	sourness	dist. of naph. with alkylene oxide and org. acid salt	Pure Oil Co.	2,755,545
Reaction	hydrocarbons	fluent mass of heated pebbles	Phillips Petroleum Co.	2,776,249
Reactivation	hydrogenation cats.	suspension in inert liquid	Rheinpreussen AG	2,775,607
Recovery	aromatics	extractive dist.	California Research Corp.	2,775,627
	durene	successive crystallization	Esso Research & Engrg. Co.	2,776,328
	ethylene	chilling & distillation	Phillips Petroleum Co.	2,777,305
	ethylene glycol	cat. isolation of propylene glycol	Jefferson Chemical Co., Inc.	2,775,623
	fluidized solids fines	liquid scrubbing	Standard Oil Co. (Ind.)	2,776,930
	oils	selective solvent extraction	Phillips Petroleum Co.	2,777,800
	xylene isomers	crystallization & separation	Standard Oil Co. (Ind.)	2,777,888
Removal	ash-formers	washing of residual oils	General Electric Co.	2,774,722
	H_2S & free O_2	heat exchanger separator	Standard Oil Co. (Ind.)	2,775,311
	tert. olefins	perfluoro-organic acid	Esso Research & Engrg. Co.	2,775,633
Selective removal	acetylene	hydrog. using promotive Fe oxide cat.	Phillips Petroleum Co.	2,775,634
	CO from olefins	alkalized Fe oxide-Cr oxide	Phillips Petroleum Co.	2,775,637

Rugged De Laval centrifugal compressors perform dependably in heavy-duty continuous operation. De Laval has more than 40 years of experience in solving gas compression problems.



Patents (continued)

FOR . . .	OF . . .	WITH . . .	ASSIGNEE . . .	PATENT . . .
Separation	acidic gases	absorbent medium	Union Oil Co. of Calif.	2,776,870
	alkyl benzenes	Werner complex	Union Oil Co. of Calif.	2,774,802
	aromatics	extractive distillation	Houdry Process Corp.	2,776,936
	ethane oxid. prods.	compresion & absorption	National Research Corp.	2,775,600
Stabilization	fuel oil	oxid. & Carbon-alkali treat.	Socony Mobil Oil Co., Inc.	2,774,721
Sweetening	hydrocarbon distillate	NaHO-isopropyl alc. & azeo dist.	Esso Research & Engrg. Co.	2,776,929
Synthesis	hydrocarbons	hydrogenation of CO	Koppers Co., Inc.	2,775,512
Temperature control	regenerator	fluid hydroforming system	Esso Research & Engrg. Co.	2,777,804
Treating	hydrocarbons	thiourea adduct	M. H. Gorin & L. Rosenstein	2,774,752
Treatment	carbonaceous solids	volatile constituent removal	M. W. Kellogg Co.	2,775,551
Two-stage reaction	fluids	removal of refractory solids	Phillips Petroleum Co.	2,775,635
Vacuum distillation	oils	flashing-distillation system	Phillips Petroleum Co.	2,774,723

Products

Assistance	cold starting	diesel engine supp. fuel	The Texas Co.	2,774,656
Bonding	rubber and fabric	copolymer adhesive	Phillips Petroleum Co.	2,774,703
	rubber mat'ls	double cements on dissimilar matl	Esso Research & Engrg. Co.	2,775,537
Composition	fuel oil	antisediment formation additive	Esso Research & Engrg. Co.	2,776,878
	gasoline	additive of lube oil et al.	Cities Service R & D Co.	2,776,194
Crank case lube	lube oil	acenaphthene	Ethyl Corp.	2,777,820
Extreme press. lube	aliphatic monoethers	citric acid additive	Shell Development Co.	2,774,733
	mineral lube oil	Pb tallate & chlorin. paraf. wax	Standard Oil Co. (Ind.)	2,775,558
Fungicide	wetting agent	toxic amount of isothiourea salt	Shell Development Co.	2,774,706
Knock-suppression	engine fuels	monohydric alc.-thallous formate	California Research Corp.	2,776,262
Lubricant	lube oil	metal salt detergency additive	Gulf Research & Development Co.	2,776,260
	lube oil	aliphatic phosphonate additive	Shell Development Co.	2,777,819
Lubricant	mineral lube oil	alkylene polyamine	Phillips Petroleum Co.	2,775,559
	mineral lube oil	corrosion inhibiting additives	Shell Development Co.	2,775,560
Oxidate	foots oil fraction	solvent deoiling process	Sinclair Refining Co.	2,776,309
Polyamide resin	reaction	diamine & aliph. dicarboxylic acid	California Research Corp.	2,776,950

(Continued on p. 158)

DE LAVAL
CENTRIFUGAL
COMPRESSOR

helps boost cat-cracker capacity at Shell Oil of Canada, Limited

To obtain extra capacity, the Montreal East refinery of the Shell Oil Company of Canada, Limited decided to rebuild its cat-cracker. Since the modernized cracking unit required a greater volume of air, Shell of Canada selected a dependable De Laval centrifugal compressor handling 16,400 cfm.

This compressor operates at an inlet pressure of 14.3 psia and a discharge pressure of 42.8 psia. The power required is 1860 bhp with the compressor operating at 5400 rpm.

The Shell Oil Company of Canada, Limited is another refinery which has chosen De Laval compressors for heavy-duty continuous service. Whether you need to handle light or heavy gases at high or low pressures in catalytic cracking, reforming, alkylation, coking or any similar service, it pays to look to De Laval.

Send for Bulletin 0504

DE LAVAL *Centrifugal Compressors*

DE LAVAL STEAM TURBINE COMPANY

900 Nottingham Way, Trenton 2, New Jersey

DL379

Patents (continued)

FOR . . .	OF . . .	WITH . . .	ASSIGNEE . . .	PATENT . . .
Resin	epoxide	alkenyloxybenzene	Shell Development Co.	2,774,748
	reaction	amide-ald.-acyclic monohydroxy. alc.	Union Oil Co. of Calif.	2,776,949
Thixotropic comp.	mineral oil	microcrystalline wax	Research Products Corp.	2,775,561

Equipment

Concentration	liquids	low temp. evap. & part. vac.	Blaw-Knox Co.	2,777,514
Contacting	gases and liqs.	countercurrent treating chamber	Houdry Process Corp.	2,776,820
	gases and liqs.	tank apparatus	Columbia-Southern Chemical Corp.	2,776,122
	immiscible liqs.	extraction contact trays	Esso Research & Engrg. Co.	2,775,542-3
	part. misc. liqs.	transverse imperforate plates	Esso Research & Engrg. Co.	2,777,758
Control	solids flowrate	conduit with rotating collectors	Phillips Petroleum Co.	2,776,786
Conversion	fluid reactants	moving gran. contact mat'l.	Socony Mobil Oil Co., Inc.	2,776,876
	hydrocarbons	continuously circ. gran. cat.	Houdry Process Corp.	2,775,547-8
Distillation	fluids	horizontal vessel	Foster Wheeler Corp.	2,776,938
Fixation	atmospheric nitrogen	fixed bed refractory-type heater	Babcock & Wilcox Co.	2,776,872
Handling	carbon black	collecting & conveying system	Phillips Petroleum Co.	2,776,725
Injection	fuels	viscosity compensating nozzle	Phillips Petroleum Co.	2,775,484
Location	liquid interfaces	electric apparatus in tube	Sinclair Oil & Gas Co.	2,776,563
Lubrication	steam devices	lube injection cylinder	Sinclair Refining Co.	2,776,729
Measurement	fluid flowrate	impeller type device	Esso Research & Engrg. Co.	2,775,125
	liquid flowrates	temp. responsive pressure bulbs	Shell Development Co.	2,777,325
	solids flowrates	system using aerating gas	Esso Research & Engrg. Co.	2,776,566
Movement	fluids	gas-powered pump	Phillips Petroleum Co.	2,774,310
Recovery	shale oil & gases	retorting tower	Foster Wheeler Corp.	2,774,726
Removal	granular solids	disengager on contact chamber	Socony Mobil Oil Co., Inc.	2,774,440
Separation	crude oil & gases	vertical separator chamber	Gulf Oil Corp.	2,774,442
	gas mixtures	cooling-distillation system	M. W. Kellogg Co.	2,777,299
	solids and gases	cyclonic-type vessel	Esso Research & Engrg. Co.	2,776,727
	oil and gases	baffled spherical separator	Graver Tank & Mfg. Co., Inc.	2,777,533
Shutoff	excess temperature	temp.-responsive check valve	Standard Oil Co. (Ind.)	2,774,366
Size reduction	coke particles	attriter with movable target	Esso Research & Engrg. Co.	2,776,799
Transfer	heat	pebble heating chamber	Phillips Petroleum Co.	2,774,572

TAYLOR-WHARTON GAS TRANSPORTS

provide compact, mobile, economical gas storage

Today many users of bulk compressed gases are turning to Taylor-Wharton Gas Transports for substantial savings and greater flexibility of operations.

Low initial cost, economical gas storage and extreme mobility are some of the advantages which make this unit especially attractive as compared with permanent bulk storage.

Numerous oil refining, petro-chemical, food and electronic companies have found that the use of transports is a practical answer to their needs for interplant haulage and standby equipment.

All transports consist of a group of 2400 p.s.i. seamless steel storage pressure vessels (ICC3A2400) securely mounted to standard semi-trailer chassis. The tubes are valved and manifolded together to a single common outlet within a rear mounted weatherproof cabinet. Capacities range from 38,500 cu. ft. to 56,250 cu. ft. depending on type of gas and size of unit.

For further information, send for our brochure describing these units, mentioning type of gas and storage requirements.

More than a century in Harrisburg

DIVISION OF

Taylor-Wharton Co. **Harsco Corporation** **Harrisburg 23, Pennsylvania**

Corrosioneering News

Quick facts about the services and equipment available to help you reduce corrosion and processing costs.

Published by The Pfaudler Co., Rochester, N.Y., U.S.A.

Pilot Plant Spans Pharmaceutical Operations—Almost any operation in pharmaceutical manufacture can be performed in this new 4 x 9 x 2½-ft. pilot plant unit designed for Lakeside Laboratories, Milwaukee, by Pfaudler. It can reflux, react, distill and handle quickly a host of functions. High-vacuum distillation is done at as low as 50 microns Hg absolute pressure. All of the equipment is made of Type 316 stainless steel.

Unusual pilot plant assembly steps up Lakeside's synthetic work

"Virtually all pilot plant operations in pharmaceutical chemistry can be performed in a single new compact assembly specially designed for Lakeside Laboratories, Inc.," states Joseph N. Jacques, plant engineer.

The assembly, part of the expanding synthetic chemistry division, was made to Lakeside specifications by Pfaudler. It requires a floor space of only 4 feet by 9 feet by 30 inches.

It can reflux, react, distill and handle quickly a host of physical and chemical functions. The new unit is particularly noteworthy because high vacuum distillations are achieved at as low as 50 microns Hg absolute pressure.

Made entirely of Type 316 stainless steel, it will handle most of the organics used in Lakeside's products. It is presently used for distilling N-Ethyl-3-Hydroxypiperidine.

All of the initial synthetic work is concentrated on the production of antispasmodics, produced under the trade names of "Dactil," "Piptal," and "Cantil." The staff has found the equipment fast, versatile and easy to manipulate, Mr. Jacques said. The unit can be used for small-scale pilot plant operations as well as full-scale production.

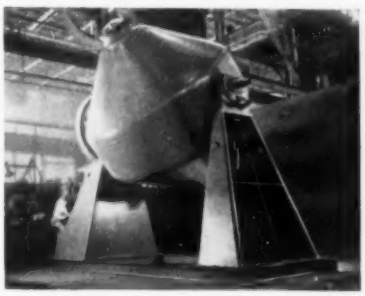
Low-cost corrosion-resistant "Chemstors" widely used for storing organics and inorganic acids, polyvinyls, distilled and potable water, etc. Glassed steel prevents product contamination, is easy to clean. Sizes range from 750 to 35,000 gallons (above). Horizontal or vertical construction.

Test glassed steel dryer-blender obtains amazing results for users

On test at one of the leading pharmaceutical companies recently, the new Pfaudler glassed steel dryer-blender (patents applied for) came through with flying colors on several products.

The most difficult test, done first, involved a material that had the consistency of whipped cream. The results were amazing, and *proved that one Pfaudler unit could be used to dry seven to ten different products, replacing three conventional tray dryers of 100 trays each!*

Results like these speak for themselves and in this instance the manufacturer placed an order for a 6-ft. Pfaudler dryer-blender on the spot. You are invited to test your products in our laboratory test blender, sending your own men along to observe results, if desired. Or, we can arrange to send a field unit to your plant.



One of the biggest built so far—255 cu. ft. Fully charged this blender weighs 20,000 lbs. Heavy-duty gear drive tumbles bucket at 8 RPM with 15 HP motor. Magnetic brake gives instant and positive control.

THE PFAUDLER CO.
Dept. PP-3, Rochester 3, N.Y.

Please send me the following:

☐ Chemstor Tanks, Bulletin 918;

☐ Dryer-Blender Data Sheet 26.

Name.....

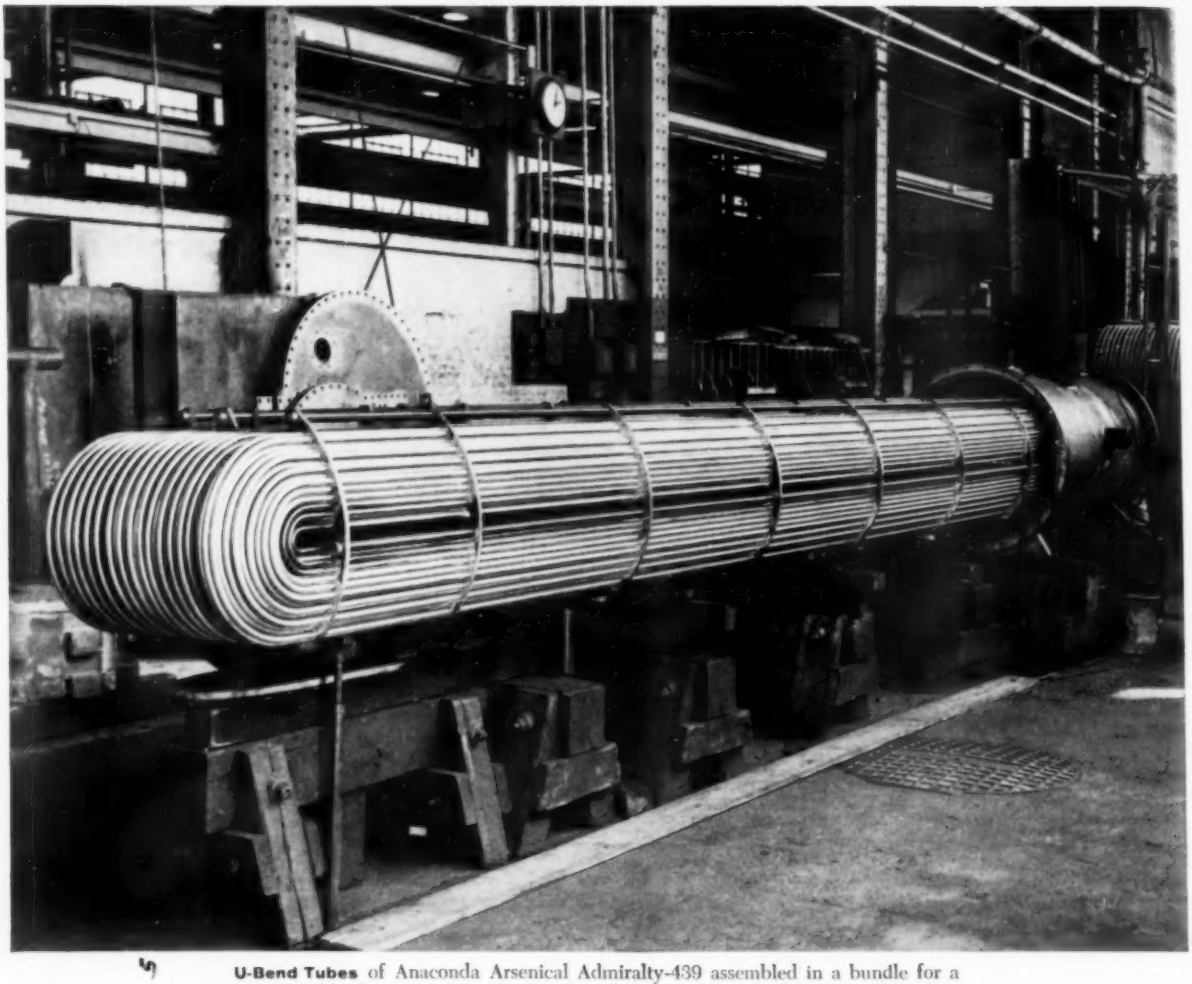
Title.....

Company.....

Address.....

City..... Zone..... State.....

(To obtain more data on advertised products see page 170)



U-Bend Tubes of Anaconda Arsenical Admiralty-439 assembled in a bundle for a horizontal feed-water heat exchanger by The Griscom-Russell Co., Massillon, Ohio.

Arsenical Admiralty U-Bend Tubes make a compact power station feed-water heater

This compact tube bundle contains 436 Anaconda Arsenical Admiralty-439 tubes, ⅝-inch OD x .049-inch gage, averaging 45 feet long. The bundle is now operating in a power station feed-water heater.

The American Brass Company is constantly studying corrosion problems affecting condensers and heat exchangers—and is a leader in the development of alloys to help meet these problems. Arsenical Admiralty-439 is but one of its many contributions in the field.

Full Range Available. Anaconda heat exchanger and condenser tubes are made for all sizes and kinds of shell-and-tube, submerged, spray-tower, and finned-atmospheric heat transfer equipment – for operation at elevated temperatures in conformance with ASME standards for allowable stresses.

Technical Assistance. The Technical Department of The American Brass Company is regularly helping manufacturers, power companies, marine operators, petroleum and chemical companies to select the correct tube alloy for many types of condensers and heat exchangers. This service is available to you without obligation. Write: The American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ont.

5781

ANACONDA®

Tubes and Plates for

Condensers and Heat Exchangers

How to use written information

Documentation in Action, edited by Jesse H. Shera, Allen Kent and James W. Perry, 1956, 6 x 9 in., 471 pp., indexed stiff cloth cover, $10.00, Reinhold Publishing Corp., 430 Park Ave., New York 22, N. Y.

IN THIS age of great complexities and overwhelming "must reading" for the technical man, more efficient methods for utilizing the printed word are needed.

Every area of science is faced with the need of using graphic records—yet the tools for handling specialized communications are far from adequate. *Documentation in Action* is the result of a preliminary planning conference sponsored by the School of Library Science of Western Reserve University to begin coping with documentation problems. Representatives of industrial, governmental, and educational organizations particularly active in improving the accessibility of recorded information were invited.

The planning conference developed seven basic questions needing answers before a better flow of recorded information could be possible: 1) how is information used by different professional activities, 2) what are modern bibliographic needs, and how do they differ, 3) what is the present state of methods, systems, equipment, 4) what principles can be evolved to improve methods, systems, equipment, 5) how can present methods be modified to meet future needs, 6) how can large scale documentation centers adapt themselves to specific needs, and 7) how will the new methods affect training programs in colleges and universities?

The conference resulting from this preplanning was cosponsored by eleven organizations, presented thirty-seven panel talks and full-scale papers and six closed discussions in specialized fields. A total of 674 persons were registered, from thiry-four states and six foreign countries, and representing 351 different industrial, governmental, professional and academic organizations.

The conference summarized the present state of the art of effectively presenting information (pointing to areas needing future study), and establishing the machinery for further such conferences.

The book giving the written record of the conference, *Documentation in Action*, is divided into five main parts: 1—recapitulation of the "state of the art," 2—use of machines, education, systems, cooperation and language, 3—summary of the panel discussions, 4—conclusions reached by closed meetings to discuss cooperative programs in metals, pharmaceuticals, petroleum, documentation, patents, and machine translation, and 5—summary of planning group conclusions defining areas for future research.

Book Briefs

Up-to-date engineering mathematics

Modern Mathematics for the Engineer, edited by Edwin F. Beckenbach, 1956, 6 x 9 in., 514 pp., illustrated, indexed, stiff cloth cover, $7.50, McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 36, N. Y.

The text is unique in its emphasis on the importance of stochastical analysis, the theory of games, operations analysis, and linear, nonlinear, and dynamic programming in modern engineering. Methods and applications of the new high-speed computation procedures are extensively covered.

Edited by Professor Beckenbach, in the mathematics department of the University of California, Los Angeles, nineteen contributions by experts give a broad survey of the application of advanced mathematics.

Kinetic reactor design

Chemical Engineering Kinetics, by J. M. Smith, 1956, 6 x 9 in., 402 pp., illustrated, indexed, stiff cloth cover, $8.00, McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 36, N. Y.

Bringing the engineering approach to engineering problems met in the design and operation of reaction equipment is a novel and useful approach found in this book, making it differ from the usual chemical kinetics book.

Numerical examples of all the important principles have been designed to illustrate a single point, and have been simplified to avoid extraneous difficulties. The relationship between surface adsorption and catalytic reactions is considered in detail. The complex problem of reactor design where temperatures and concentration changes occur is handled with illustrative examples.

The author, J. M. Smith, is Professor of Chemical Engineering and Assistant Director, Engineering Experiment Station, Purdue University.

Practical process economics

Chemical Process Economics in Practice, edited by J. James Hur, 1956, 5 x 7½ in., 115 pp., illustrated, table of contents, stiff cloth cover, $3.95, Reinhold Publishing Corp., 430 Park Ave., New York 22, N. Y.

Chemical Process Economics in Practice records the proceedings of the fourth "Experience in Industry" symposium jointly sponsored by the Philadelphia-Wilmington Section of the American Institute of Engineers and the School of Chemical Engineering, University of Pennsylvania.

Nine recognized experts in chemical process economics (representing refining, petrochemical, chemical and engineering and construction companies) discussed accounting terms, total initial capital investments, pitfalls of cost accounting, indirect investment and costs of services, distribution of indirect costs, relationship of price to value, making a concise profit picture, and financing original costs and operations of a new plant.

Economic refinery scheduling

Scheduling of Petroleum Refinery Operations, by Alan S. Manne, 1956, 6 x 9 in., 185 pp., illustrated, indexed, stiff cloth cover, $5.00, Harvard University Press, Cambridge, Mass.

The author, an economist for Rand Corp., reviews conventional refinery cost accounting methods, then presents four case studies to support his belief that the economist and the petroleum industry planner can effectively help each other.

Case studies cover the allocation of individual crude oils to several refineries at different locations, naphtha reforming, gasoline blending, and scheduling for a small integrated plant that performs cracking, recycling, and blending.

The individual calculations in the examples show the refiner how to better understand needs to respond to changes in prices, quality needs, and needs for new equipment.

A Progress Report on Faculty Salaries:

UP . . . But Not Nearly Enough

THE CHART on this page provides a report of the progress being made in solving a problem of crucial importance to every American. The problem is that of seeing that college and university faculty members get decent salaries.

This new chapter, which brings the story forward two years—from 1954, when it was last dealt with in this series of editorials, through 1956—has a decidedly cheering element. For in the last two years faculty salaries have made real headway.

Two Years of Improvement

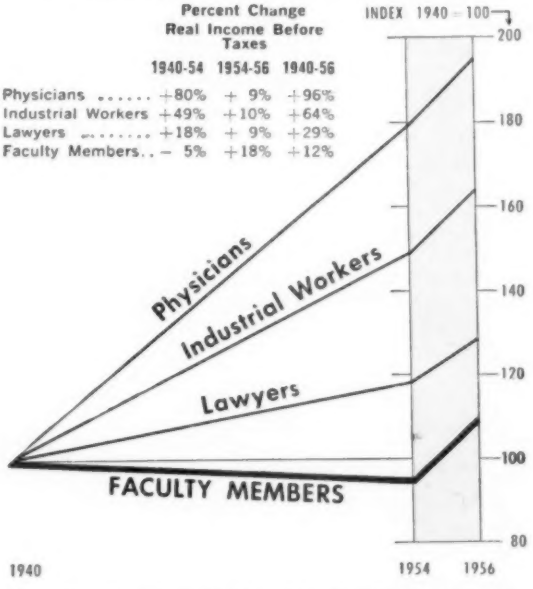
In 1954, in terms of what their salaries would buy, faculty members as a whole were actually worse off, by 5%, than they had been fourteen years earlier. As the chart shows, over the same period the real income of the average industrial worker had increased by almost half. And, in what it would buy, the income of the average physician, with professional training comparable to that of the average faculty member, had jumped by 80%.

In 1956, however, the average faculty salary would buy about 12% more of goods and services than it would in 1940. Relative to where they were two years before, faculty salaries showed a larger gain over the two years than those of any of the other groups whose salary progress is charted.

This movement of faculty salaries in the right direction has many contributing causes. The biggest single boost was given by the great Ford Foundation gift of half a billion dollars to our colleges, universities, and hospitals, almost half of which was ear-marked for faculty salary increases. Gifts from business firms have also

What is Happening to College Faculty Salaries

Percent Change Real Income Before Taxes	1940-54	1954-56	1940-56
Physicians	+80%	+ 9%	+96%
Industrial Workers	+49%	+10%	+64%
Lawyers	+18%	+ 9%	+29%
Faculty Members	– 5%	+18%	+12%



DATA: Council for Financial Aid to Education, U. S. Dept. of Commerce, U. S. Dept. of Labor, National Association of Education Research Dept., McGraw-Hill Dept. of Economics.

helped a lot. And so, in many cases, have stepped-up money-raising campaigns by alumni groups and cooperative regional and state groups of colleges.

Still a Long Way to Go

However, faculty salaries started their ascent from such a dismal depth that they still have a long, long way to go up before there is room for the comfortable conviction that they are fair, or even safe, from the standpoint of protecting the nation's vital interests. It still remains possible to find many shocking companion pieces for the following incident recently reported to a McGraw-Hill executive group, working on problems of financial aid to higher education, by the president of an illustrious small liberal arts college.

"The recruiting officer of one of our large industrial companies came to our campus a few weeks ago," the college president said, "and offered five of our seniors higher salaries to start working for that company when they are graduated next June than the salary received by any member of our faculty. And the seniors, of course, promptly went to their professors to seek advice on whether or not they should accept. It doesn't take much imagination to see what this sort of thing does to the morale of a faculty."

Senior Teachers Fare Badly

One of the more devastating things it does, of course, is to make the more experienced college and university faculty members receptive to the idea of going to greener pastures, currency-wise, in business and industry.

For these senior faculty members the financial pounding in the past 16 years has been even worse than the chart indicates. While the average real salary gain reported by the chart has been 12%, the average salary of a full professor still buys less than it did in 1940. This is because most of the salary increases have gone to beginning instructors, for whose services industry has been providing the sort of competition reported by the liberal arts college president.

And it creates this financial lackluster of posts as senior college faculty members right at the time their services are needed more than ever to handle the oncoming flood of college and university students. Between now and 1970 college and university enrollment is expected to double.

What is Needed Now

What is clearly needed is a continuation and intensification of the drive to increase their salaries to a point where college and university faculty members will be sharing somewhere near fully in the general prosperity of the nation. It could be counted good progress in this direction if over the next two years faculty salaries on the average were to go up another 12%, with most of the increase concentrated in the senior faculty ranks. And this can be made possible only through more outside contributions.

There is reason to be encouraged by the progress that has been made over the past two years in bailing college and university faculty members out of the terrible financial hole into which they were allowed to slide. But there is the most urgent occasion to keep at it and harder.

This message is one of a series prepared by the McGraw-Hill Department of Economics to help increase public knowledge and understanding of important nationwide developments that are of particular concern to the business and professional community served by our industrial and technical publications.

Permission is freely extended to newspapers, groups or individuals to quote or reprint all or parts of the text.

Donald C. McGraw

PRESIDENT

McGRAW-HILL PUBLISHING COMPANY, INC.

CLASSIFIED

UNDISPLAYED RATE

$1.50 a line. Minimum 3 lines. To figure advance payment count 5 average words as a line. (see ¶ on Box Numbers.)

POSITION WANTED. Undisplayed rate is one half of above rate, payable in advance.

PROPOSALS, $1.50 a line an insertion.

INFORMATION:

BOX NUMBERS count one additional line in undisplayed ads.

DISCOUNT OF 10% if full payment is made in advance for four consecutive insertions of undisplayed ads (not including proposals).

AN ADVERTISING INCH is measured ⅞ inch vertically on one column, 3 columns—30 inches—to a page.

DISPLAYED RATE

The advertising rate is $13.50 per inch for Equipment and Business Opportunity advertising appearing on other than a contract basis. Contract rates quoted on request.

Employment advertising rate is $13.50 per inch and is subject to Agency Commission.

Send NEW ADVERTISEMENTS to Classified Advertising Division, PETROLEUM PROCESSING, P.O. Box 12, N. Y. 36, N. Y.—SECTION CLOSES March 26th for the April issue.

ESSO ENGINEERING EXPANSION NEEDS

Chemical engineer needed for expanding plant scale research program on newly developed petroleum and petrochemical process equipment.

Work involves establishing incentives for commercial tests, planning program, directing test work in the field, and interpreting significance of data obtained. Frequent travel to different refinery locations.

Job requires sound knowledge of chemical engineering principles and ability to deal with practical plant problems. Prefer man with one to five years experience.

Give full details of education, experience, desired salary, availability date and references. All inquiries will be considered promptly and held confidential.

ESSO RESEARCH AND ENGINEERING COMPANY
(Chief Technical Subsidiary-Standard Oil Company (New Jersey))
Esso Research Center, Employee Relations-C
P. O. Box 51, Linden, N. J.

ENGINEERING RESEARCH

We have openings for a limited number of technically trained people with exceptional qualifications in the following fields:

Chemical Engineering — **Metallurgy**
Process Engineering — **Electronics**
Mechanical Engineering — **Corrosion**
Engineering Economics

If you are seeking a challenging position in any of these or related fields, we would welcome the opportunity to review your qualifications.

Engineering Research Department
STANDARD OIL COMPANY
Whiting, Indiana

HEAT TRANSFER ENGINEER

Young man 28 to 40 years capable of design, rating and sales of heat exhangers. Established fabricator located in S.W. City of 300,000.

Reply stating full particulars as to education, employment background and qualifications.

Salary commensurate with experience and ability. All replies kept confidential.

P-4217 Petroleum Processing
520 N. Michigan Ave., Chicago 11, Ill.

REFINERY ENGINEER

Process engineering position with large independent company operating in Mid-Continent area. One to five years experience desired. State qualifications and give salary requirements.

Cooperative Refinery Association
Box 7305, Kansas City 16, Missouri

STEEL PIPE & TUBING

• Chrome Moly • Carbon Moly • Heavy Walls
• Carbon Steel • Stainless • Large O.D.
Widest Range of Sizes & Specs in the U.S.
WRITE FOR STOCK LIST

MIDCONTINENT TUBE SERVICE, INC.
2308 Oakton St., Evanston, Ill. DA 8-4030

FOR RATES OR INFORMATION

About Classified Advertising,

Contact
The McGraw-Hill Office Nearest You.

ATLANTA, 3
1301 Rhodes-Haverty Bldg.
JAckson 3-6951
M. MILLER

BOSTON, 16
350 Park Square Bldg.
HUbbard 2-7160
H. J. SWEGER

CHICAGO, 11
530 No. Michigan Ave.
MOhawk 4-5800
W. HIGGENS
J. BRENNAN

CINCINNATI, 37
1825 Yorktown Rd.
Swifton Village, Apt. 2
REdwood 1-3238
G. MILLER

CLEVELAND, 15
1510 Hanna Bldg.
SUperior 1-7000
W. SULLIVAN

DALLAS, 2
Adolphus Tower Bldg., Main & Akard Sts.
RIverside 7-5064
G. JONES

DETROIT, 26
856 Penobscot Bldg.
WOodward 2-1793
W. STONE

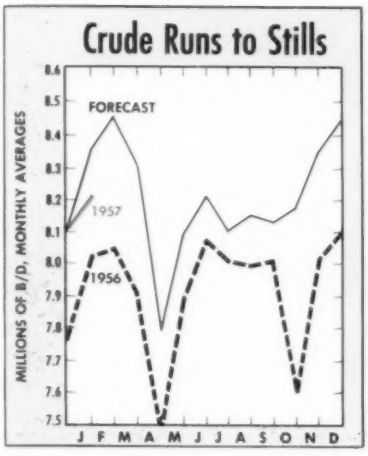
LOS ANGELES, 17
1125 W. 6th St.
MAdison 6-9351
P. CARBERRY
D. McMILLAN

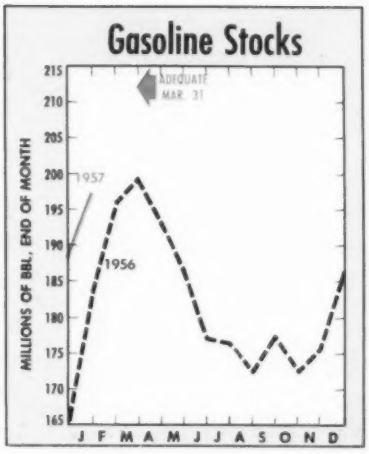
NEW YORK, 36
330 West 42 St.
LOngacre 4-3000
S. HENRY
D. COSTER
R. LAWLESS

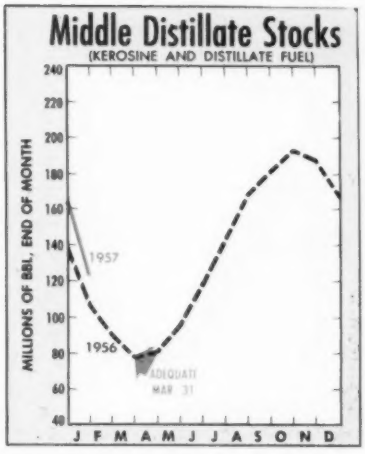
PHILADELPHIA, 3
17th & Sansom St.
RIttenhouse 6-0670
H. BOZARTH

ST. LOUIS, 8
3615 Olive St.
JEfferson 5-4867
W. HIGGENS

SAN FRANCISCO, 4
68 Post St.
DOuglas 2-4600
W. WOOLSTON






Middle Distillate Stocks
(KEROSINE AND DISTILLATE FUEL)
MILLIONS OF BBL, END OF MONTH
1957
1956
ADEQUATE MAR. 31
J F M A M J J A S O N D

Crude runs still on the high side

JANUARY and early February figures show refiners are adjusting their operations to the emergency demand caused by the closing of the Suez Canal. Crude runs to stills, averaging around 8,195,000 b/d, were still 2.5% larger than for the same weeks in 1956. Individual companies have announced further cuts in their runs to stills.

For the period from Nov. 1-Jan. 30, the emergency shipments to Europe have averaged 439,000 b/d, of which 231,000 bbl was crude, distillate fuel and kerosine 124,000 bbl, gasoline 54,000 bbl, residual fuels 23,000 bbl, and other products 7,000 b/d.

With this additional demand, inventories of distillate and residual fuels have been reduced and, aided by a large increase in domestic demand, gasoline inventories have not built up at the rate of a year ago. These inventories in early February, however, were in line with anticipated coming demand needs.

OUTLOOK: With export shipments, second quarter gasoline demand may reach 4,400,000 bbl daily avg.

In coming weeks oil companies will be balancing loads on both shoulders to take care of new export requirements and yet not unbalance inventories when they return to normal demands.

Total U.S. gasoline inventories Feb. 9 had increased only 14,100,000 bbl since Dec. 28, while a year ago these stocks built up by 22,350,000 bbl in the same period. Gasoline stocks Feb. 8 were 12,300,000 bbl higher than on Feb. 10, 1956, while at the start of the year they were close to 20,000 greater (API data).

Even with distillate fuel oils figuring in the emergency export shipments total U.S. stocks Feb. 8 were 16% greater than on Feb. 10, 1956. Heating oil requirements have been about normal, temperature-wise. Residual fuel oil inventories were about in line with a year ago.

JANUARY KEY STATISTICS

(Figures given in terms of millions of b/d, monthly averages, except stocks, which are in millions of bbl at end of month)

	Jan 1957	Dec 1956	Jan 1956
CRUDE OIL			
U. S. Production	7.411	7.373	7.199
Imports	.790	.856	.805
U. S. Stocks	254.048	263.025	261.592
Runs to Stills	8.208	8.101	8.023
GASOLINE			
Refinery Output	3.904	3.954	3.843
Refinery Demand	3.707	3.715	3.336
Primary Stocks	195.906	186.230	183.905
MIDDLE DISTILLATES			
Refinery Output	2.452	2.367	2.308
Refinery Demand	3.728	3.094	3.324
Primary Stocks	126.006	165.549	107.451
RESIDUALS			
Refinery Output	1.271	1.236	1.344
Imports & Other	.541	.615	.605
Total Supply	1.812	1.851	1.949
Refinery Demand	1.950	1.906	1.980
Primary Stocks	38.400	42.685	38.247

PRODUCT AND CRUDE PRICES

(Products—¢ gal, weighted average prices in principal refinery markets
Crudes—$/bbl, principal fields
Source—Platt's Oilgram Price Service

	Jan. 1957	Dec. 1956	Jan. 1956
Gasoline (regular)	12.39	11.98	11.81
Distillate Fuel Oil	10.13	9.69	9.41
Kerosine	11.69	11.22	10.85
Residuals	6.33	6.00	5.09
Above 4 Products	10.19	9.80	9.39
Lube Oils	23.28	22.86	21.03
Crude	3.14	2.88	2.83

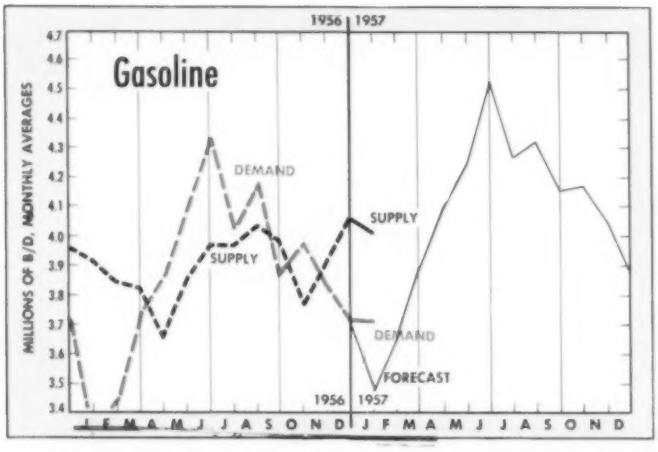
REFINERY YIELDS

% on Crude Runs to Stills

	Jan. 1957	Dec. 1956	Jan. 1956
Gasoline	43.5	44.1	43.0
Kerosine	4.6	4.7	4.7
Distillate	25.3	24.5	23.7
Residuals	15.5	15.3	16.5

SOURCE OF DATA (Except prices): Dec. and Jan., API weekly reports; earlier months, Bureau of Mines

Winter Domestic Gasoline Demand Is High

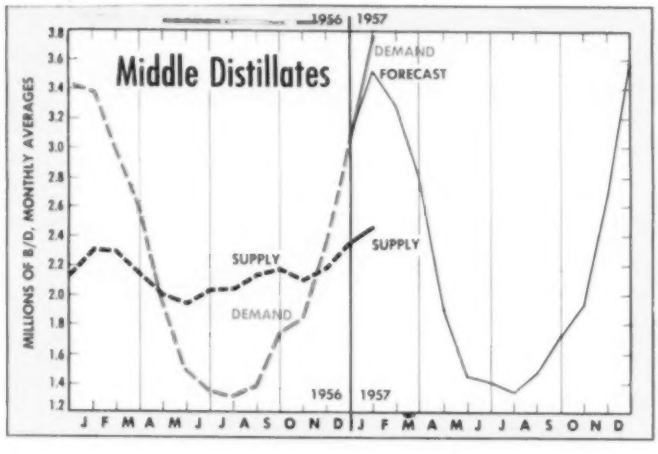

Gasoline
1956 | 1957
MILLIONS OF B/D, MONTHLY AVERAGES
DEMAND
SUPPLY
SUPPLY
DEMAND
FORECAST
1956 1957
J F M A M J J A S O N D J F M A M J J A S O N D

MOTOR FUEL

	From Crude	From Nat. Gas	Total
SUPPLY (Millions of b/d)			
Jan. '57	3.573	.446	4.019
Jan. '56	3.492	.435	3.927
Change	+ .081	+ .011	+ .092
% Change	+ 2.3	+ 2.5	+ 2.3
DEMAND (including Exports) (Millions of b/d)			
Jan. '57			3.707
Jan. '56			3.336
Change			+ .371
% Change			+ 11.1
TOTAL SUPPLY (Millions of bbl)			
12 Mos. '56	1,262.603	166.282	1,428.885
12 Mos. '55	1,205.146	168.804	1,373.950*
Change	+ 57.457	— 2.522	+ 54.935
% Change	+ 4.8	— 1.5	+ 4.0
TOTAL DEMAND (including Exports) (Millions of bbl)			
12 Mos. '56			1,415.147
12 Mos. '55			1,368.726*
Change			+ 46.421
% Change			+ 3.4

*Bureau of Mines figures have been revised upward.

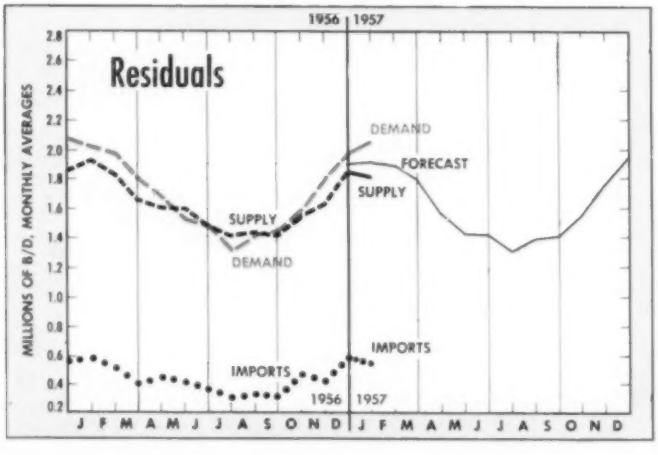
Exports and Home Needs Build Up Distillate Demand


Middle Distillates
1956 | 1957
MILLIONS OF B/D, MONTHLY AVERAGES
DEMAND
FORECAST
SUPPLY
SUPPLY
DEMAND
1956 1957
J F M A M J J A S O N D J F M A M J J A S O N D

MIDDLE DISTILLATES

	Kerosine	Dist. Fuel Oil	Total
PRODUCTION (Millions of b/d)			
Jan. '57	.376	2.076	2.452
Jan. '56	.385	1.923	2.308
Change	—.009	+ .153	+ .144
% Change	— 2.3	+ 8.0	+ 6.2
DEMAND (including Exports) (Millions of b/d)			
Jan. '57	.595	3.133	3.728
Jan. '56	.569	2.755	3.324
Change	+ .026	+ .378	+ .404
% Change	+ 4.6	+ 13.7	+ 12.2
TOTAL PRODUCTION (Millions of bbl)			
12 Mos. '56	123.630	665.785	789.415
12 Mos. '55	117.137	602.547	719.684
Change	+ 6.493	+ 63.238	+ 69.731
% Change	+ 5.5	+ 10.5	+ 9.7
TOTAL DEMAND (including Exports) (Millions of bbl)			
12 Mos. '56	120.833	651.835	772.668
12 Mos. '55	120.143	605.733	725.876
Change	+ .690	+ 46.102	+ 46.792
% Change	+ 0.6	+ 7.6	+ 6.4

Residual Supply, Shipments, About in Balance



RESIDUAL FUELS

	Refinery Output	Imports & Other	Total
SUPPLY (Millions of b/d)			
Jan. '57	1.271	.541	1.812
Jan. '56	1.344	.605	1.949
Change	— .073	—.064	— .137
% Change	— 5.4	—10.6	— 7.0
DEMAND (including Exports) (Millions of b/d)			
Jan. '57			1.950
Jan. '56			1.980
Change			— .030
% Change			— 1.6
TOTAL SUPPLY (Millions of bbl)			
12 Mos. '56	425.093	169.415	594.508
12 Mos. '55	420.331	157.594	577.925
Change	+ 4.762	+ 11.821	+ 16.583
% Change	+ 1.1	+ 7.5	+ 2.9
TOTAL DEMAND (including Exports) (Millions of bbl)			
12 Mos. '56			590.797
12 Mos. '55			590.856
Change			— .059
% Change			0

SOURCE OF DATA: Dec. and Jan., API weekly reports; earlier months, Bureau of Mines (1956 figures for 366 days)

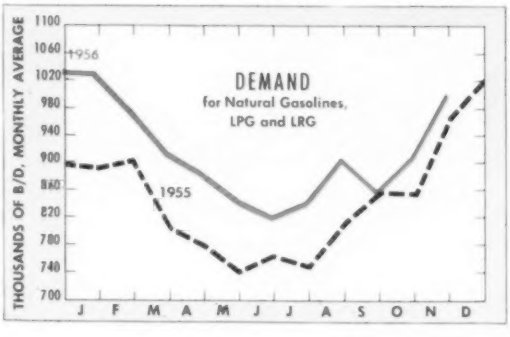
RUNS TO STILLS AND DISTRIBUTION OF PRIMARY STOCKS BY U.S. REFINERY DISTRICTS

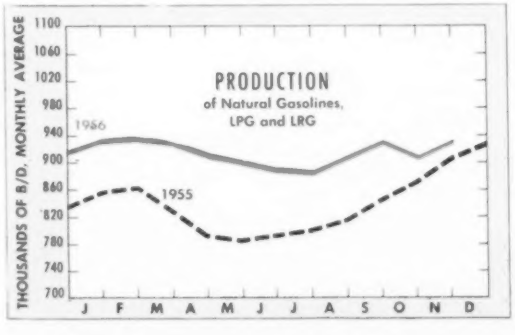
(Primary stocks include those at refineries, at large terminals and in pipelines; all data based on API reports)

District	RUNS TO STILLS (Millions of b/d average for week ending on date shown) Feb. 8 1957	Feb.10 1956	Change	% Change	GASOLINE STOCKS (Millions of bbl on date shown) Feb. 8 1957	Feb.10 1956	Change	% Change	RESIDUAL STOCKS (Millions of bbl on date shown) Feb. 8 1957	Feb.10 1956	Change	% Change
East Coast	1.205	1.087	+ .118	+10.9	40.811	36.335	+ 4.476	+12.3	8.782	10.793	— 2.011	—18.6
Gulf Coast	2.705	2.716	— .011	— 0.4	40.844	38.520	+ 2.324	+ 6.0	7.514	7.861	— .347	— 4.4
Total Coastal	3.910	3.803	+ .107	+ 2.8	81.655	74.855	+ 6.800	+ 9.1	16.296	18.654	— 2.358	—12.6
Appalachian	.206	.207	— .001	— 0.5	8.054	7.554	+ .500	+ 6.6	.679	.688	— .009	— 1.3
Ind.-Ill.-Ky.	1.480	1.533	— .053	— 3.5	40.313	39.008	+ 1.305	+ 3.3	4.623	3.863	+ .760	+19.7
Okla.-Kans.-Mo.	.764	.747	+ .017	+ 2.3	23.038	21.767	+ 1.271	+ 5.8	1.221	.898	+ .323	+36.0
Other Inland	.700	.652	+ .048	+ 7.4	21.483	19.675	+ 1.808	+ 9.2	3.000	2.161	+ .839	+38.8
Total Inland	3.150	3.139	+ .011	+ 0.4	92.888	88.004	+ 4.884	+ 5.5	9.523	7.610	+ 1.913	+25.1
Total East of Calif.	7.060	6.942	+ .118	+ 1.7	174.543	162.859	+11.684	+ 7.2	25.819	26.264	— .445	— 1.7
Calif.	1.142	1.074	+ .068	+ 6.3	25.352	24.759	+ .593	+ 2.4	11.223	11.463	— .240	— 2.1
Total U. S.	8.202	8.016	+ .186	+ 2.3	199.895	187.618	+12.277	+ 6.5	37.042	37.727	— .685	— 1.8

District	DISTILLATE FUEL OIL STOCKS (Millions of bbl on date shown) Feb. 8 1957	Feb.10 1956	Change	% Change	KEROSINE STOCKS (Millions of bbl on date shown) Feb. 8 1957	Feb.10 1956	Change	% Change	TOTAL MIDDLE DISTILLATE STOCKS (Millions of bbl on date shown) Feb. 8 1957	Feb.10 1956	Change	% Change
East Coast	33.816	28.314	+ 5.502	+19.4	10.553	8.844	+ 1.709	+19.3	44.369	37.158	+ 7.211	+19.4
Gulf Coast	12.369	12.877	— .508	— 3.9	3.899	3.757	+ .142	+ 3.8	16.268	16.634	— .366	— 2.2
Total Coastal	46.185	41.191	+ 4.994	+12.1	14.452	12.601	+ 1.851	+14.7	60.637	53.792	+ 6.845	+12.6
Appalachian	3.078	2.050	+ 1.028	+50.1	.877	.827	+ .050	+ 6.0	3.955	2.877	+ 1.078	+37.5
Ind.-Ill.-Ky.	16.309	13.327	+ 2.982	+22.4	4.796	4.513	+ .283	+ 6.3	21.105	17.840	+ 3.265	+18.3
Okla.-Kans.-Mo.	11.695	8.457	+ 3.238	+38.2	1.417	.824	+ .593	+71.9	13.112	9.291	+ 3.831	+41.3
Other Inland	6.172	5.360	+ .812	+15.1	1.727	1.051	+ .676	+64.3	7.899	6.411	+ 1.488	+23.2
Total Inland	37.254	29.194	+ 8.060	+27.6	8.817	7.215	+ 1.602	+22.2	46.071	36.409	+ 9.662	+26.5
Total East of Calif.	83.439	70.385	+13.054	+18.5	23.269	19.816	+ 3.453	+17.4	106.708	90.201	+16.507	+18.3
Calif.	10.077	10.184	— .107	— 1.1	.345	.253	+ .092	+36.4	10.422	10.437	— .015	— 0.1
Total U. S.	93.516	80.569	+12.947	+16.1	23.614	20.069	+ 3.545	+17.7	117.130	100.638	+16.492	+16.4

Natural Gas and Refinery Gas Liquids





SUPPLY AND DEMAND STATISTICS

(Bureau of Mines Data)

CURRENT PRODUCTION (1000 b/d monthly average)	Nov. 1956	Oct. 1956	Nov. 1955
At Natural Gasoline and Cycling Plants			
Liquefied Petroleum Gas	443	403	419
Natural Gasoline and Isopentane	277	293	281
Condensate	21	18	24
Finished Gasoline, Naphtha and other	67	68	63
Total Natural Gasoline and Cycling Plant Production	808	782	787
Liquefied Refinery Gases	138	136	122
Total Marketable Gas Liquids	946	918	909
Lease Condensate	132	122	118
Total Natural Gas Liquids	1,078	1,040	1,027

CURRENT DEMAND (1000 b/d monthly average)			
LPG and LRG	622	515	591
Natural Gasoline, Isopentane and other	368	379	377
Total Marketable Gas Liquids	990	894	968

CUMULATIVE PRODUCTION (1000 bbl)	Nov. 1956	Nov. 1955
LPG and LRG	182,920	157,832
Natural Gasoline, Isopentane and other	126,232	120,888
Total Marketable Gas Liquids	309,152	278,720

CUMULATIVE DEMAND (1000 bbl)		
LPG and LRG	177,028	154,579
Natural Gasoline, Isopentane and other	119,070	121,798
Total Marketable Gas Liquids	296,098	276,377

STOCKS (1000 bbl, end of month)	Nov. 1956	Oct. 1956	Nov. 1955
LPG and LRG	16,649	17,889	11,011
Natural Gasoline, Isopentane and other	5,127	5,214	4,216
Total Stocks	21,776	23,103	15,227

INFORMATION OFFERED

Do you need detailed information on a specific subject? Check through this easy-to-use index of literature and data being offered in this issue's advertisements.

ANALYZER, infrared, for process stream control, booklet; Mine Safety Appliances Co. See adv't. p. 31.

CATALYSTS, booklet; Harshaw Chemical Co. See adv't. p. 1.

CATHODIC PROTECTION, anodes, reports on installations; Duriron Co. See adv't. p. 21.

CONTROLLER, small size, bulletin 98278; Taylor Instrument Cos. See adv't. pp. 52-53.

COMBUSTION UNITS, submerged, bulletin 110; Thermal Research & Engineering Corp. See adv't. p. 182.

COMPRESSORS, centrifugal, bulletin 0504; De Laval Steam Turbine Co. See adv't pp. 156-157.

DERMATITIS PREVENTION, hand cleaner, booklet; West Disinfecting Co. See adv't. p. 189.

ETHANOLAMINES, samples and information on request, Nitrogen Division, Allied Chemical & Dye Corp. See adv't. p. 114.

EXPANSION JOINTS, catalog; Solar Aircraft Co. See adv't. p. 146.

FILTERS, for petroleum liquids, technical literature; Commercial Filters Corp. See adv't. p. 18.

FLUID CONTROL systems, bulletin F1-56; Hetherington & Berner, Inc. See adv't. p. 186.

FURFURAL, for solvent extraction, bulletin 203-A; Quaker Oats Co. See adv't. p. 56.

GAGE ILLUMINATOR, data unit; Jerguson Gage & Valve Co. See adv't. p. 144.

GASKET MATERIALS, asbestos, bulletin SP-23; Greene, Tweed & Co. See adv't. p. 178.

GASKET MATERIALS, "Teflon," information; Polychemicals Dept., DuPont Co. See adv't. p. 91.

GASKETS, "Teflon," booklet; Crane Packing Co. See adv't. p. 135.

GASKETS, many types for refineries, catalog, Melrath Supply & Gasket Co. See adv't. p. 111.

GASKETS, corrugated metal, catalog; Chicago-Wilcox Mfg. Co. See adv't. p. 136.

GLASSED STEEL equipment, tanks, dryer-blenders, bulletin 918, data sheet 26; Pfaudler Co. See adv't. p. 159.

GRATING AND WALKWAYS, steel, catalog PP-37; Rockwell Spring & Axle Co. See adv't. p. 190.

GRINDERS, portable, air operated, bulletin 61; Airetool Mfg. Co. See adv't p. 188.

HEAT EXCHANGERS, evaporative type, bulletin 120; Niagara Blower Co. See adv't. p. 198.

HEATERS for crude oil, burns fluid coke, booklet; Foster Wheeler Corp. See adv't. p. 142.

HEATERS, gradiation, bulletin 133; Selas Corp. of America. See adv't. p. 179.

HEATERS, vertical or horizontal, bulletin 498; National Airoil Burner Corp. See adv't. p. 148.

JACKETING, for pipes, protects insulation, engineering data and sample; Childers Mfg. Co. See adv't. p. 24.

MASTIC COATINGS, for tanks, information; Insul-Mastic Corp. of America. See adv't. p. 191.

MECHANICAL SEALS, catalog 480; Durametallic Corp. See adv't. p. 190.

MIXERS, side and top entering, portable, eight catalogs and data sheets; Mixing Equipment Co., Inc. See adv't. p. 58.

MOTOR STARTERS, high voltage, bulletin 8131-C; Electric Controller & Mfg. Co., Square D Co. See adv't. p. 28.

OCTANE RESEARCH, booklet; Ethyl Corp. See adv't. p. 4-5.

PACKING RINGS, for pumps and valves, catalog; Allpax Co., Inc. See adv't. p. 126.

PAINT STRIPPER, chemical, special report and handbook F-7893; Oakite Products, Inc. See adv't. p. 20.

PIPE, plastic lined, corrosion resistant, information; Dow Chemical Co. See adv't. p. 54.

PIPE, steam traced, aluminum, booklet; Aluminum Co. of America. See adv't. p. 11.

PROCESS EQUIPMENT, fabrication, booklet; Newport News Shipbuilding & Dry Dock Co. See adv't. p. 40.

PUMP VALVES, information; Madsen Works, B-L-H Corp. See adv't. p. 183.

PUMPS, for hot oil, coke pulverizing, bulletin 106; Bingham Pump Co. See adv't. p. 55.

PUMPS, high pressure, catalog HP-1254; Philadelphia Pump & Machinery Co. See adv't. p. 19.

PUMPS, top and end suction, top discharge, bulletin B-1605; Peerless Pump Div. See adv't. p. 141.

PURGE METER, for higher pressures, bulletin 120; Brooks Rotameter Co. See adv't. p. 136.

REFINING RESEARCH, booklet describes importance of research; Universal Oil Products Co. See adv't. pp. 38-39.

SOLVENT DECARBONIZING, booklet describes process; M. W. Kellogg Co. See adv't. p. 48.

SPECTROMETRY INSTRUMENTS, for analysis and control, nine bulletins available on specific instruments; Consolidated Electrodynamics Corp. See adv't. pp. 32-33.

STEAM TRAPS, bulletin 10-55; W. H. Nicholson & Co. See adv't p. 93.

STORAGE UNITS, for compressed gas, mobile, brochure; Taylor-Wharton Co. See adv't. p. 158.

TANK EQUIPMENT, conservation vents, tank gages, catalog P-7R; Vapor Recovery Systems Co. See adv't. p. 194.

TANK VENTS, chart; Jordan Corp. See adv't. p. 134.

THERMOMETERS, red mercury, bulletin 35; Palmer Thermometers, Inc. See adv't. p. 138.

TOWER PACKING, for scrubbing operations, bulletin S29-R; U. S. Stoneware Co. See adv't. p. 154.

TREATING, chemical, electrofining, bulletin; Petreco Div., Petrolite Corp. See adv't. p. 120.

TUBE MAINTENANCE TOOLS, expanders and cutters, catalog 81; Gustav Wiedeke Co. See adv't. p. 196.

TUBES, furnace, centrifugally cast, bulletin T-283; Electro-Alloys Div., American Brake Shoe Co. See adv't. p. 130.

VALVES, gate, steel, information; Crane Co. See adv't p. 116.

VALVES, control, high pressure, bulletin 9400; Annin Co. See adv't. p. 200.

VALVES, and fittings, stainless steel, folder; Copper Alloy Corp. See adv't. p. 203.

VALVES, general purpose, supplement No. 1 to catalog F-9; Henry Vogt Machine Co. See adv't. p. 185.

WEATHERPROOFING, for insulation, asphalt base, brochure; American Bitumuls & Asphalt Co. See adv't p. 202.

—Photograph courtesy of Standard Oil Company (N. J.)

How much can preheat raise throughput?

Today's soaring production costs spotlight the need for increasing throughput . . . that is, if slim profit margins are to be kept from disappearing altogether. A look at the Ljungstrom Air Preheater will show how this can be done.

Ljungstrom efficiency comes from the fact that preheated air mixes more thoroughly with fuel. This assures more complete combustion . . . higher flame temperature . . . and increased heat absorption into the tubes – which raises still throughput by as much as 25%!

For example, an eastern refinery went from 16,000 barrels to 18/20,000 barrels a day when the pipe still was modernized with a Ljungstrom system. In addition, temperature control was much closer. The octane rating of the product, because of this fine control, was held to narrower limits – *with the average rating as much as two octane numbers higher.*

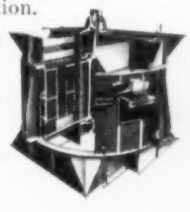
How fast is "WRITE OFF"?

In earnings from increased output and improved quality, many refineries write off the cost of the Ljungstrom in less than 2 years. These costs can be written off sooner, in fact, when you add other Ljungstrom advantages: savings up to 20% in fuel costs . . . higher throughput . . . less slag . . . and use of fuels you used to discard.

For more complete data on what the Ljungstrom Air Preheater can do for you . . . for an analysis of the heat recovery benefits obtainable in fuel burning equipment – call or write the Air Preheater Corporation.

Wherever You Burn Fuel, You Need Ljungstrom

The Ljungstrom operates on the continuous regenerative counterflow principle. The heat transfer surfaces in the rotor act as heat accumulators. As the rotor revolves, the heat is transferred from the waste gases to the incoming cold air.



The Air Preheater Corporation 60 East 42nd Street, New York 17, N. Y.

Petroleum Processing

ADVERTISERS' INDEX

For information on any product or service in this issue see Area "B" on opposite page.

A

Adsco Industries, Inc. (A-4) 6
Air Preheater Corp. (K-3) 169
Airetool Mfg. Co. (M-1) 188
Allied Chemical & Dye Corp., Nitrogen Div. (F-6) 114
Allpax Co., Inc. (G-4) 126
Aluminum Co. of America (A-6) 11
American Bitumuls & Asphalt Co. (N-8) 202
American Cyanamid Co., Refinery Chemicals Dept. (B-8) 26-27
Anaconda Co. (K-2) 160
Annin Co. (N-5) 200

B

Babcock & Wilcox Co., Tubular Products Div. (M-9) 195
Babcock & Wilcox Co., Boiler Div. (C-6) 36
Baker & Adamson Chemicals, Allied Chemical & Dye Corp. (O-1) ..... Cover 3
Betz, W. H. & L. D. (J-5) 151
Bingham Pump Co. (E-5) 55
Black, Sivalls & Bryson, Inc. (K-8) 180
Blaw-Knox Co. (A-9) 17
Brooks Rotameter Co. (H-1) 136

C

Catalytic Construction Co. (D-6) 46
Chicago Bridge & Iron Co. (A-5) 8
Chicago-Wilcox Mfg. Co. (H-2) 136
Childers Mfg. Co. (B-6) 24
Commercial Filters Corp. (B-1) 18
Conax Corp. (L-3) 183
Consol. Electrodynamics Corp. (C-3) 32-33
Cooper Alloy Corp. (N-9) 203
Cooper-Bessemer Corp. (D-1) 41
Crane Co. (F-7) 116
Crane Packing Co. (G-9) 135
Crawford Fitting Co. (J-2) 148

D

Dean Brothers Pumps, Inc. (M-6) 192
De Laval Steam Turbine Co. (J-8) 156-157
Delta Tank Mfg. Co., Inc. (B-7) 25
Dow Chemical Co. (E-4) 54
Dowell, Inc. (F-9) 121
DuPont de Nemours & Co., Inc., Petroleum Chemicals Dept. (J-6) 152
DuPont de Nemours & Co., Inc., Petroleum Chemicals Dept. (C-1) 29-30
DuPont de Nemours & Co., Inc., Polychemicals Dept. (E-9) 91
Durametallic Corp. (M-3) 190
Duriron Co. (B-4) 21

E

Electric Controller & Mfg. Co., Square D. Co. (B-9) 28
Electro Alloys Div., American Brake Shoe Co. (G-7) 130
Enjay Co. (L-6) 185
Esso Research & Engr. Co. (D-4) 44
Ethyl Corp. (A-3) 4-5
Ever-Tite Coupling Co., Inc. (G-6) 128

F

Faul & Timmins, Inc. (F-1) 92
Fisher Governor Co. (B-5) 22-23
Flexitallic Gasket Co. (F-3) 94
Foster Wheeler Corp. (H-7) 142
Frick Co. (L-5) 184

G

Garlock Packing Co. (F-5) 112-113
Graver Tank & Mfg. Co. (A-8) 14
Greene, Tweed & Co. (K-6) 178
Griphoist, Inc. (N-6) 200

H

Harshaw Chemical Co. (A-2) 1
Hetherington & Berner, Inc. (L-8) 186
Hudson Engineering Corp. (A-1) ..... Cover 2

I

Insul-Mastic Corp. of America (M-5) 191
International Nickel Co. (L-9) 187

J

Jerguson Gage & Valve Co. (H-8) 144
Johns-Manville Corp. (H-9) 145
Jordan Corp. (G-8) 134

K

Kellogg Co., M. W., Refinery Process Div. (D-8) 48
Koppers Co., Inc. (E-1) 50

L

Lummus Co. (A-7) 13

M

Madsen Works, B-L-H Corp. (L-2) 183
McKee Co., Arthur G. (D-2) 42
Melrath Supply & Gasket Co. (F-4) 111
Metallo Gasket Co. (L-7) 186
Mine Safety Appliances Co. (C-2) 31
Mixing Equipment Co. (E-8) 58

N

National Airoil Burner Co. (J-3) 148
Natural Gasoline Supply Men's Assoc. 132
Newport News Ship Building & Drydock Co. (C-9) 40
Niagara Blower Co. (N-3) 198
Nicholson & Co., W. H. (F-2) 93

O

Oakite Products, Inc. (B-3) 20
Oil Industry Information Comm. (D-5) 45
Olin-Mathieson Chemical Corp. (D-7) 47
Oronite Chemical Co. (D-3) 43

P

Palmer Thermometers, Inc. (H-5) 138
Patent Scaffolding Co., Inc. (N-4) 199
Peerless Pump Div. (H-6) 141
Petreco Div., Petrolite Corp. (F-8) 120
Petro-Chem Development Co., Inc. (G-1) 122
Pfaudler Co. (K-1) 159
Philadelphia Pump & Machinery Co. (B-2) 19
Powell Co., William (G-5) 127
Procon, Inc. (N-7) 201
Purolator Products, Inc. (H-3) 137

Q

Quaker Oats Co. (E-6) 56

R

Refinery Engineering Co. (E-2) 51
Ridge Tool Co. (K-9) 181
Rockwell Spring & Axle Co. (M-4) 190
Rockwell-Nordstorm Valves (C-4) 34

S

Selas Corp. of America (K-7) 179
Sentinel Glass Co. (L-4) 184
Shell Oil Co. (C-5) 35
Solar Aircraft Co. (J-1) 146
Solvay Process Div., Allied Chemical & Dye Corp. (H-4) 138
Square D Co., Detroit Div. (M-7) 193

T

Taylor Instrument Cos. (E-3) 52-53
Taylor-Wharton Co. (J-9) 158
Thermal Research & Engr. Corp. (L-1) 182
Tretolite Div., Petrolite Corp. (C-7) 37

U

U. S. Gasket Co. 112-113
U. S. Steel Corp. (D-9) 49
U. S. Stoneware Co. (J-7) 154
Universal Oil Products Co. (C-8) 38-39
Universal Oil Products Co., Products Dept. (K-5) 177

V

Vapor Recovery Systems Co. (M-8) 194
Vogt Machine Co., Henry (N-2) 197

W

Warren Petroleum Corp. (E-7) 57
West Disinfecting Co. (M-2) 189
Western Supply Co. (G-3) 125
Wiedeke Co., Gustav (N-1) 196
Wolverine Tube, Div. Calumet & Hecla, Inc. (J-4) 149-150
Wyatt Metal & Boiler Works (O-2) ..... Cover 4

Z

Zimmerman Packing Co. (G-2) 124
Zink Co., John (K-4) 176

CLASSIFIED ADVERTISING
F. J. Eberle, Business Mgr.

EMPLOYMENT OPPORTUNITIES 164
EQUIPMENT (Used or Surplus New) For Sale 164

Regional Sales Representatives

Kenneth W. McKinley, Adv. Sales Mgr.

New York 36, N. Y., 330 West 42nd St., Walter W. Patten, Kenneth S. Willadsen, Longacre 4-3000

PHILADELPHIA 3, PA. 17th and Sansom Sts., Walter R. Donahue, Rittenhouse 6-0670

ATLANTA, GA., 1301 Rhodes-Haverty Bldg., M. H. Miller, Jackson 3-6951

CLEVELAND 15, OHIO, 1510 Hanna Bldg., William R. Freeman, Superior 1-7000

CHICAGO 11, ILL., 520 No. Michigan Ave., Fred R. Emerson, Mohawk 4-5800

HOUSTON 25, TEXAS, Prudential Bldg., Edward E. Schirmer, Locust 1281

DALLAS 1, TEXAS, 1712 Commerce St., Edward E. Schirmer, Riverside 7-5117

SAN FRANCISCO 4, CAL., 68 Post St., William C. Woolston, Douglas 2-4600

LOS ANGELES 17, CAL., 1125 West 6th St., Peter S. Carberry, Madison 6-9351

ENGLAND, LONDON, E. C. 4, Peter Lagler, McGraw-Hill Co., Ltd., 95 Farrington St.

This index is published as a convenience. Every care is taken to make it accurate, but PETROLEUM PROCESSING assumes no responsibility for errors or omissions

You can use these handy

Reader Service Cards for

- (A) More details on What's New
- (B) Information from Advertisers
- (C) Reprints of Editorial Articles
- (D) New or Renewal Subscriptions

(A) Are You Up-to-Date on What's New?

. . . get the **latest** details on the **newest** in—

- Equipment and materials
- Services
- Helpful literature

Read the reviews in the **What's New** section on the following pages, pick out the items that interest you, then circle the corresponding number in Area **"A"** on the **Reader Service Card.**

(B) More on Advertised Products

. . . do you want to know more about products or services advertised in this issue of PETROLEUM PROCESSING, or get copies of the literature offered in the ads? Refer to the **Advertisers' Index** on the preceding page for key numbers to circle in Area **"B"** on the **Reader Service Card.**

(C) Special Reprints Available

. . . do you need reprints of PETROLEUM PROCESSING's special reports, articles or **Data Sheets?** If so, see the other side of this sheet for order numbers and prices, then use Area **"C"** on the **Reader Service Card** to order them. We'll bill you later.

(D) Are You a "Pass-on" Reader?

. . . get your own personal copy of PETROLEUM PROCESSING promptly every month at low rates. Just check your choice in Area **"D"** on the **Reader Service Card**—we'll send your bill later, after you start getting your copies.

READER SERVICE CARD

(A) WHAT'S NEW ITEMS *Circle proper number*

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100

(B) ADVERTISED PRODUCTS *See Index on facing page*

A1	B1	C1	D1	E1	F1	G1	H1	J1	K1	L1	M1	N1	O1	P1	Q1	S1	T1	U1	V1
A2	B2	C2	D2	E2	F2	G2	H2	J2	K2	L2	M2	N2	O2	P2	Q2	S2	T2	U2	V2
A3	B3	C3	D3	E3	F3	G3	H3	J3	K3	L3	M3	N3	O3	P3	Q3	S3	T3	U3	V3
A4	B4	C4	D4	E4	F4	G4	H4	J4	K4	L4	M4	N4	O4	P4	Q4	S4	T4	U4	V4
A5	B5	C5	D5	E5	F5	G5	H5	J5	K5	L5	M5	N5	O5	P5	Q5	S5	T5	U5	V5
A6	B6	C6	D6	E6	F6	G6	H6	J6	K6	L6	M6	N6	O6	P6	Q6	S6	T6	U6	V6
A7	B7	C7	D7	E7	F7	G7	H7	J7	K7	L7	M7	N7	O7	P7	Q7	S7	T7	U7	V7
A8	B8	C8	D8	E8	F8	G8	H8	J8	K8	L8	M8	N8	O8	P8	Q8	S8	T8	U8	V8
A9	B9	C9	D9	E9	F9	G9	H9	J9	K9	L9	M9	N9	O9	P9	Q9	S9	T9	U9	V9

(C) REPRINTS AVAILABLE *See listing on next page*

R1	R4	R7	R10	R13	R16	R19	R22	R25	R28	R31	R34	R37	R40	R43	R46
R2	R5	R8	R11	R14	R17	R20	R23	R26	R29	R32	R35	R38	R41	R44	R47
R3	R6	R9	R12	R15	R18	R21	R24	R27	R30	R33	R36	R39	R42	R45	R48

(D) NEW OR RENEWAL SUBSCRIPTION

New ☐ Renewal ☐ 1 year—$2.00 ☐ 2 years—$3.00 ☐ 3 years—$4.00 ☐

Petroleum Processing

For Issue of March, 1957 (Good until June 15, 1957)

Name *(please print)*_____

Position_____

Company_____

Business Address_____

City_____ Zone_____ State_____

FIRST CLASS
PERMIT NO. 64
(Sec. 34.9 P. L. & R.)
New York, N. Y.

BUSINESS REPLY CARD
No Postage Necessary if Mailed in the United States

4c-POSTAGE WILL BE PAID BY

PETROLEUM PROCESSING
330 WEST 42nd STREET
NEW YORK 36, N. Y.

FIRST CLASS
PERMIT NO. 64
(Sec. 34.9 P. L. & R.)
New York, N. Y.

BUSINESS REPLY CARD
No Postage Necessary if Mailed in the United States

4c-POSTAGE WILL BE PAID BY

PETROLEUM PROCESSING
330 WEST 42nd STREET
NEW YORK 36, N.Y.

READER SERVICE CARD

(A) WHAT'S NEW ITEMS *Circle proper number*

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100

(B) ADVERTISED PRODUCTS *See Index two pages back*

A1	B1	C1	D1	E1	F1	G1	H1	J1	K1	L1	M1	N1	O1	P1	Q1	S1	T1	U1	V1
A2	B2	C2	D2	E2	F2	G2	H2	J2	K2	L2	M2	N2	O2	P2	Q2	S2	T2	U2	V2
A3	B3	C3	D3	E3	F3	G3	H3	J3	K3	L3	M3	N3	O3	P3	Q3	S3	T3	U3	V3
A4	B4	C4	D4	E4	F4	G4	H4	J4	K4	L4	M4	N4	O4	P4	Q4	S4	T4	U4	V4
A5	B5	C5	D5	E5	F5	G5	H5	J5	K5	L5	M5	N5	O5	P5	Q5	S5	T5	U5	V5
A6	B6	C6	D6	E6	F6	G6	H6	J6	K6	L6	M6	N6	O6	P6	Q6	S6	T6	U6	V6
A7	B7	C7	D7	E7	F7	G7	H7	J7	K7	L7	M7	N7	O7	P7	Q7	S7	T7	U7	V7
A8	B8	C8	D8	E8	F8	G8	H8	J8	K8	L8	M8	N8	O8	P8	Q8	S8	T8	U8	V8
A9	B9	C9	D9	E9	F9	G9	H9	J9	K9	L9	M9	N9	O9	P9	Q9	S9	T9	U9	V9

(C) REPRINTS AVAILABLE *See listing*

R1	R4	R7	R10	R13	R16	R19	R22	R25	R28	R31	R34	R37	R40	R43	R46
R2	R5	R8	R11	R14	R17	R20	R23	R26	R29	R32	R35	R38	R41	R44	R47
R3	R6	R9	R12	R15	R18	R21	R24	R27	R30	R33	R36	R39	R42	R45	R48

(D) NEW OR RENEWAL SUBSCRIPTION

New ☐ Renewal ☐ 1 year—$2.00 ☐ 2 years—$3.00 ☐ 3 years—$4.00 ☐

Petroleum Processing

For Issue of March, 1957 (Good until June 15, 1957)

Name (please print) _____

Position _____

Company _____

Business Address _____

City _____ Zone ____ State ____

You can use these handy
Reader Service Cards for

- (A) More details on What's New
- (B) Information from Advertisers
- (C) Reprints of Editorial Articles
- (D) New or Renewal Subscriptions

The Latest in . . .

PETROLEUM PROCESSING Reprints

(For complete Reprint List, see p. 175)

Use **Reader Service Card Area "C"** to order the reprints you want. We'll fill your order and send you a bill. If you don't see the item you want listed below, check the additional Reprint Listings in page 175.

- **'Instrument Charts' Track Costs**—use of control charts by British American Oil Co. tells when operating charts are out of limits. 8 pages—$0.25: Reprint **R36**

- **Drafting Production Manual**—for better and faster drafting, with do-it-yourself slide rule for flange and fitting drafting data. 24 pages—$1.25: Reprint **R31**

- **Hydrogen Processing in the Refinery**—Special Report on what it is, how it works, who uses it, processes and catalysts. 24 pages—$0.75: Reprint **R30**

- **How Computers Can Help You**—valuable training and information booklet. 12 pages—$0.25: Reprint **R23**

- **The Heat Exchanger**—Special Report on design, costs and types. 32 pages—$1.00: Circle **R8**

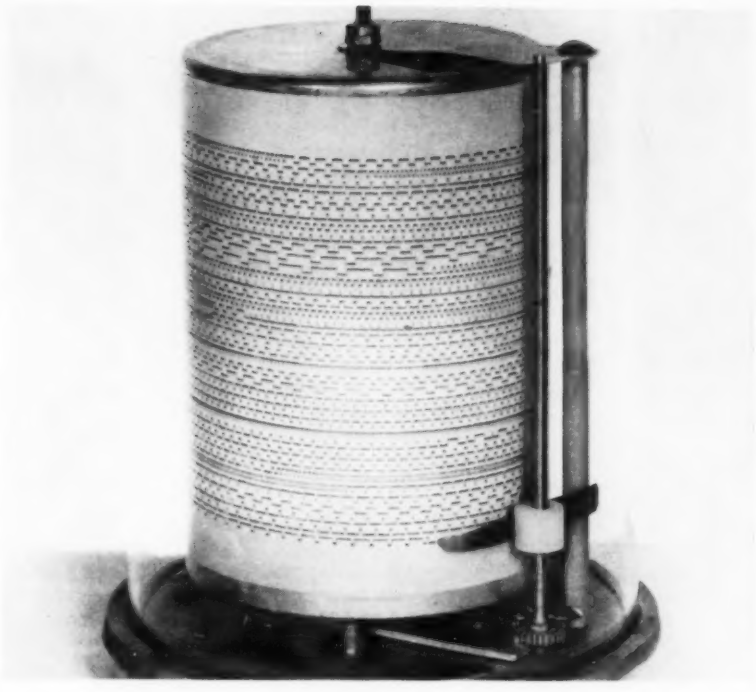
- **Vaporization Equilibrium Constant and Activity Coefficient Charts.** 48 pages—$1.50: Reprint **R1**

- **Clip•n•File Sheets**—$0.20 each, any 6 for $1.00. Process Data Sheets (PDS's) are 3-page fold-outs. Engineering Data Sheets (EDS's) are 2 pages on special, heavy paper for repeated handling and reference:

PDS 12,	**Process Reference List—1954**	Reprint **R32**
PDS 13,	**Thermofor Catalytic Reforming**	Reprint **R34**
PDS 14,	**Process Reference List—1956**	Reprint **R37**
PDS 15,	**Ammonium Nitrate**	Reprint **R39**
PDS 16,	**Chemico Nitric Acid**	Reprint **R41**
EDS 11,	**Measuring Viscosity**	Reprint **R33**
EDS 12,	**Metal Glossary**	Reprint **R35**
EDS 13,	**Plastics Glossary—A-L**	Reprint **R38**
EDS 14,	**Plastics Glossary—M-Z**	Reprint **R40**
EDS 15,	**Combustible Vapors**	Reprint **R42**

(For preceding PDS and EDS sheets, see complete listing on page 175 of this issue)

Prices for quantity order furnished on request



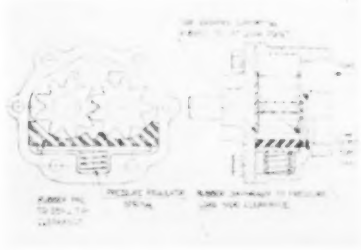
Recorder Produces simple chart

This rotating drum recorder produces a continuous record of the sequence of operation of any piece of equipment. It can be used for detective work on automatic machines or controls which may be suspected of misoperation. Or, it can be used to confirm proper functioning of new or test equipment.

The drum can be set to rotate at speeds from 4 minutes to 24 hours per revolution. The record is made by a stylus on a chart paper with a layer of white opaque wax crystals; when traced, the line shows up as a strongly contrasting red color. Because no ink is used, the record is not damaged by later handling or water damage.

More than 400 linear inches of recording can be made on a filled chart measuring only 6 x 14 inches. With the 24-hr rotational model, any given instant of successive days is instantly comparable in a vertical comparison. The driving motor and stylus magnet are concealed within the rotating drum. **Gorrell & Gorrell,** Haworth, N.J.

Circle No. **1** *on Reply Card*



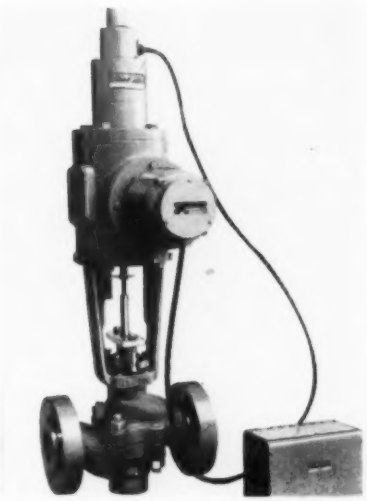
Gear pump

. . . of simple design handles fluid pressures up to 200 psi, using inexpensive gears and body housing. An ingenious arrangement of a molded synthetic rubber element, a calibrated spring, and a synthetic rubber diaphragm permit using inexpensive hobbed or rolled gears and a die-cast housing. Close finishing of pump parts is not required.

The synthetic rubber element mounted under the two mating gears gives zero clearance to the gear teeth along the pressure outlet of the pump. The calibrated spring under the clearance pad serves as a pressure relief valve. The synthetic rubber diaphragm under the two gears permits some back-lash and takes up the clearance between the upper and lower faces of the gear.

Due to free flow of fluid into the pump intake port, the output flow is maintained at a slightly higher level as temperature rises. Horsepower required to drive the pump at maximum delivery is low: at 2200 rpm, with 60 psi line pressure, the pump requires 1.2 hp with fluid at 250°F. **New Products Corp.,** 3636 Oakton St., Skokie, Ill.

Circle No. **2** *on Reply Card*



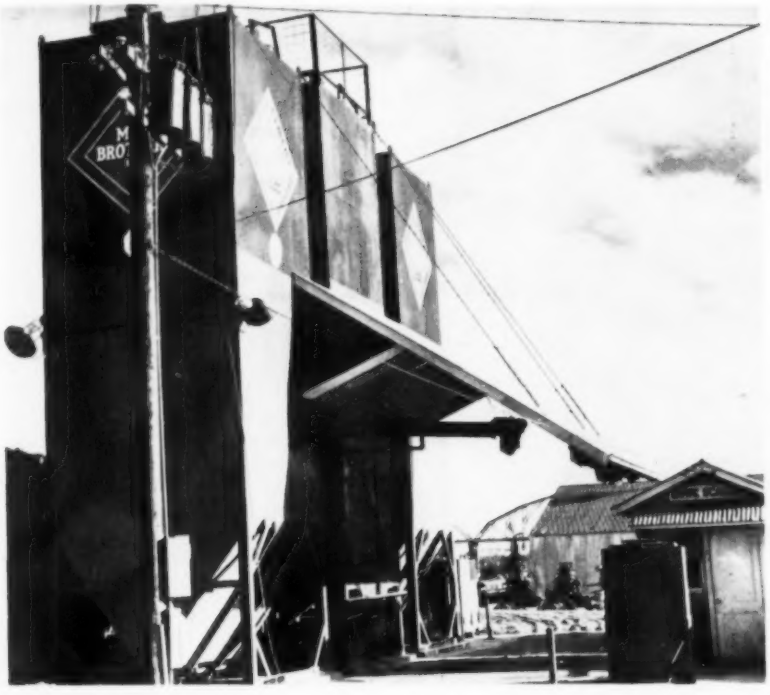
Electric actuator

. . . requires no pneumatic or hydraulic operating fluids, and can be applied to control valves, butterfly valves, proportioning pumps and speed controllers.

The Series "D" actuator can be applied to any all-electric control system. It has a stroke length of ¼- to 2-in with a stem speed of 4 in./min at the maximum rated output of 500 lb thrust. Complete assembly of motor and yoke stands 25-in. high and weighs less than 35 lb. It can be mounted in any position and is not affected by normal vibration. **Conoflow Corporation,** 2100 Arch St., Philadelphia 3, Pa.

Circle No. **3** *on Reply Card*

(Continued on next page)



Portable bulk plant

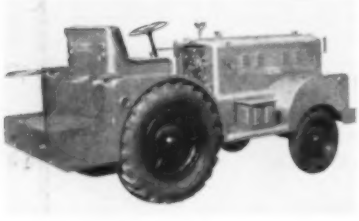
Unloads full railroad hopper car

Pulverized material from a full railroad hopper car can be unloaded in less than two hours by this piece of equipment. The same unit can be used for dead storage of 2,500 cu ft of dry granular products, and the loading of it aboard trucks at the rate of 20 cu ft/min.

Bucket-type elevators run from a base connection, designed for a screw conveyor from the railroad car, to a point five feet above the top of the plant's upper bin. Pulverized material is unloaded into the upper of two chambers. When the upper chamber is full, additional material overflows into the bottom "dead" storage chamber. As trucks are loaded from the upper section, the bucket elevator recharges the loading chamber from the lower storage section.

The combined unloading-storage-unloading plant can be moved from one site to another by fastening detachable wheels and axle to one end. The unit can then be towed behind a regular truck-tractor. Capacity of the plant can be increased by installing additional 2,500 cu ft bins on either side (as shown in the picture) and connecting them to the central unit with airslides. **Delta Tank Manufacturing Co., Inc.,** Baton Rouge, La.

Circle No. **4** *on Reply Card*



Weldmobile

. . . is a self propelled welding unit with the engine directly connected to the generator.

By traveling directly to the job and being ready to weld without waiting for electricians to hook up power lines, the unit can save time in welding jobs located at widely separated points. It has a towing capacity itself of 2,000 lb draw-bar pull, so that it can tow other equipment too.

The 400-amp model is powered by a Chrysler 6-cylinder industrial engine. The 600-amp model is powered by a Chrysler V8 industrial engine. The unit can supply up to one kilowatt (100-volts dc) auxiliary power in addition to welding power. **Hobart Brothers Co.,** Hobart Square, Troy Ohio.

Circle No. **5** *on Reply Card*

Instrument lines

. . . protected by a fire and impact resistant sheathing can be used in hazardous areas or can be buried underground.

Dekoron Super Poly-Cor is composed of a bundle of twelve ¼-in. OD, polyethylene core tubes that withstand all normal instrument line pressures. Over this bundle of tubes is extruded an extra heavy thermal and shock barrier covered with braided and fireproof AA asbestos. The entire assembly is then covered with an extruded flame-retardant outer sheath. **Samuel Moore & Co.,** Mantua, Ohio.

Circle No. **6** *on Reply Card*

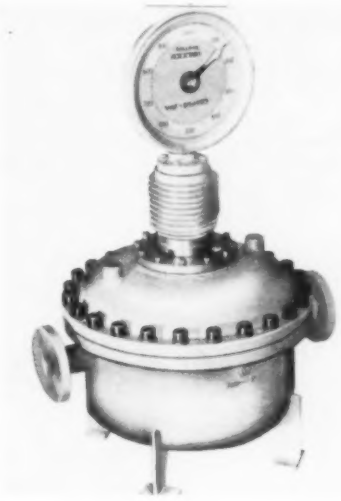
Tube cutter

. . . handles a wide range of tubing, from ⅛- to 3⅛-in. diameter. Every size of tubing is backed by two of the cutter's four rollers, so that all cuts

are straight without distorting the tube.

The Pipemaster 3T tube cutter is designed to cut copper, aluminum, brass and plastic tubing. The hook and arm are cast malleable iron, polished and chrome plated. Cutter wheels are easily changed. The small cutter weighs less than 3 lb. **Erie Tool Works,** Erie, Pa.

Circle No. **7** *on Reply Card*

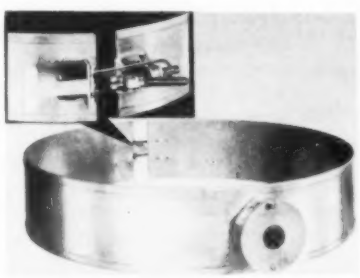


Flowmeter

. . . for hard-to-handle fluids such as bunker oils, still bottoms and asphalt has a capacity range up to 450 gpm.

The positive displacement meter is available in sizes from 1 in. to 6 in., and has operating temperature range up to 660°F. Operating pressure can be as high as 600 psi. Accuracy of the meter is guaranteed to ¼% for the 1-in. meter and ½% for the 2- to 6-in. sizes. The meter body of meehanite iron is enclosed in a steel steam jacket designed for 15-psi service. **Brooks Rotameter Co.,** Lansdale, Pa.

Circle No. **8** *on Reply Card*



Drum heater

. . . for 55-gal steel drums features a quick-action toggle clamp, a built-in

You Can Add These

PETROLEUM PROCESSING Reprints

To Your Files

Use the Reader Service Cards on pages 171-172 to order

PETROLEUM PROCESSING Special Reports:

Gaskets—How to Choose and Use Today's Gaskets in Today's Equipment, a special 16-page report by Ron Cannon: what a gasket is, how it works, types of gasketed joints, factors in gasket design, selecting materials, how to get the most out of your gaskets
Reprint **R43** $0.50

Hydrogen Processing—An Appraisal of Its Use in the Refinery, by Robert L. Davidson; what it is, how it works, what it does, who's using or planning to use it, processes and catalysts. 24 pages, December 1956
Reprint **R30** $0.75

Optimum Bubble-Cap Tray Design, by William L. Bolles; presents new concepts and easy-to-use working charts for the process design of bubble-cap trays. 51 pages, 4-part series in February, March, April and May 1956 Reprint **R15** $1.50

Chemical Treating of Petroleum Fuels, 4-article symposium on the chemical treatment of petroleum streams from crude through gasolines to convert and/or remove impurities. 24 pages, May 1956
Reprint **R12** $0.75

Catalytic Reforming—And Aromatics Recovery in the Refinery, by Virgil B. Guthrie and Robert L. Davidson; what it is and does, who's using or planning to use it, processes for reforming and aromatics recovery. 48 pages, August 1955 Reprint **R3** $0.75

Evaporation Losses—And their Control in Storage, by Willis A. Bussard; what evaporation is, storage conditions that affect it, equipment and other methods to reduce losses, estimating losses, selecting the right tank. 24 pages, July 1956 Reprint **R2** $0.75

Vaporization Equilibrium Constant and Activity Coefficient Charts, by K. A. Smith and R. B. Smith; for use in described conditions ranging up to the critical point of the system. 48 pages, December 1949
Reprint **R1** $1.50

PETROLEUM PROCESSING Data Sheets:

Process Data Sheets are process descriptions with flow diagrams, process conditions, economics, etc. 3-page fold-out sheets—$.20 each, or any 6 PDS or EDS sheets for $1.00:

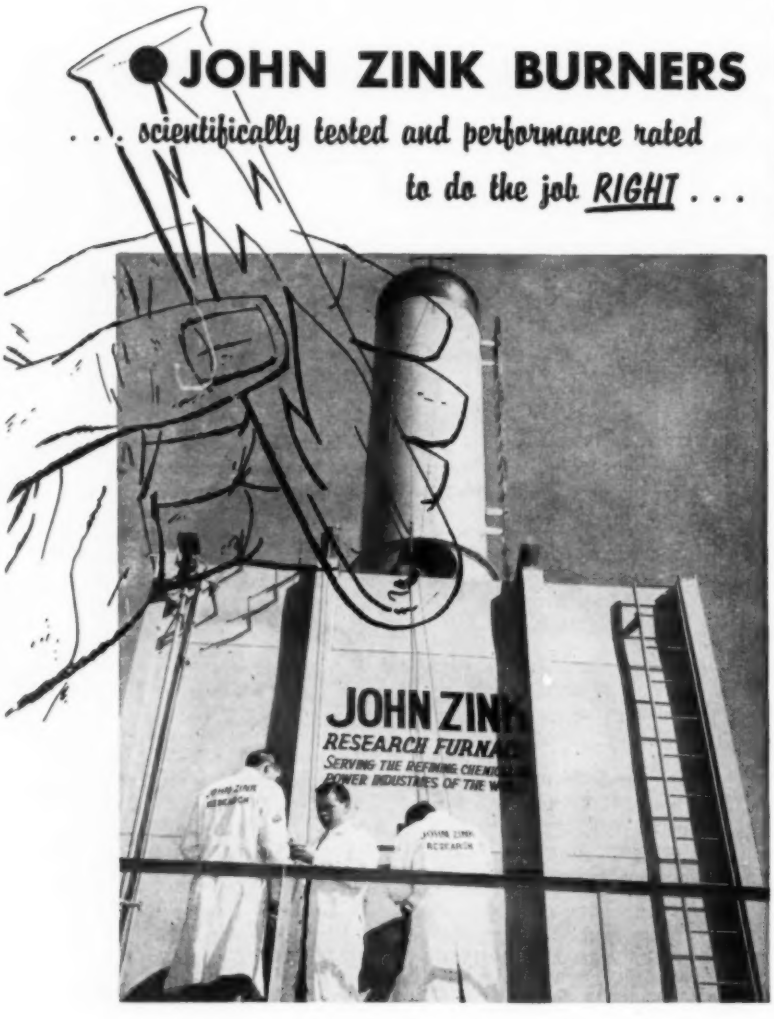
PDS 1, **Ethylene Oxide**	**R4**	PDS 9, **Process References—1947**	**R24**
PDS 2, **Butadiene • Butenes**	**R5**	PDS 10, **Ammonia—Kellogg**	**R26**
PDS 3, **L'Azote Ammonia**	**R6**	PDS 11, **Pentafining**	**R28**
PDS 4, **Ethylene—Kellogg**	**R9**	PDS 12, **Process References—1954**	**R32**
PDS 5, **Fluid Coking**	**R10**	PDS 13, **Thermofor Catalytic Reforming**	**R34**
PDS 6, **Chemico Urea**	**R16**	PDS 14, **Process References—1956**	**R37**
PDS 7, **Ethylene—Stone & Webster**	**R18**	PDS 15, **Ammonium Nitrate**	**R39**
PDS 8, **TCP—Socony Mobil**	**R21**	PDS 16, **Chemico Nitric Acid**	**R41**

Engineering Data Sheets contain basic data and information on a variety of subjects. 2 pages—$0.20 each, or any 6 EDS or PDS sheets for $1.00.

EDS 1, **Pressure Fundamentals**	**R7**	EDS 8, **Distillation Fundamentals**	**R25**
EDS 2, **Temperature Fundamentals**	**R11**	EDS 9, **Heat Fuel Comparison**	**R27**
EDS 3, **Fluid Flow Fundamentals**	**R13**	EDS 10, **Tank Capacities—II**	**R29**
EDS 4, **Flow Restrictions in Pipe**	**R14**	EDS 11, **Measuring Viscosity**	**R33**
EDS 5, **Tank Capacities—I**	**R17**	EDS 12, **Metals Glossary**	**R35**
EDS 6, **Heat—and Its Transfer**	**R19**	EDS 13, **Plastics Glossary—A-L**	**R38**
EDS 7, **Vapor Pressure**	**R22**	EDS 14, **Plastics Glossary—M-Z**	**R40**
EDS 15, **Combustible Vapors**	**R42**		

JOHN ZINK BURNERS

. . . scientifically tested and performance rated to do the job RIGHT . . .



This research furnace affords an ideal proving ground for design changes in standard lines of burners, as well as enabling the John Zink Company to find *workable* solutions to new problems. In this way the John Zink Company can offer you special burners for your individual application . . . burners that have been *performance tested* before they reach your job site.

→ *The facilities of the John Zink research furnace are available to industry.*

WE MAKE HEAT . . . AROUND THE WORLD

If you have a specialized industrial burner problem . . . JOHN ZINK has the answer . . .

JOHN ZINK COMPANY

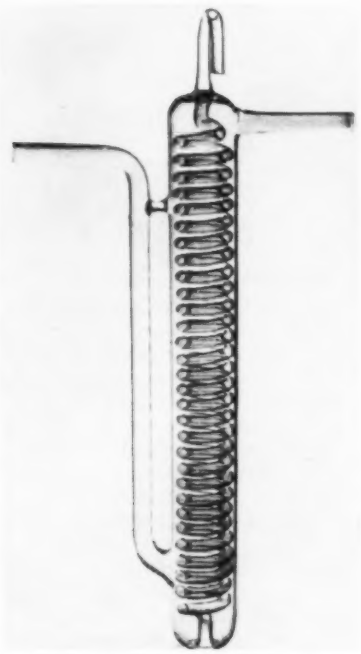
4401 SOUTH PEORIA TULSA 5, OKLAHOMA

3-heat switch, and wiring circuits said to assure uniform heating.

At the high setting of 230 volts input, each heater will deliver 3000 watts. At the medium setting, 1500 watts are delivered, and the low setting is 750 watts. Actual heat input into the drum, without thermal insulation, is said to be 65 to 85% of the generated wattage. This figure depends on the condition of the container and the heat absorbing properties of the contents.

When applied to a drum filled with a hard-to-remove material—such as plastics, adhesives or other highly viscous material—the wattage concentration of the heater is low enough through the face of it to prevent coking or burning the contents. **Acra Electric Corp.,** Franklin Park, Ill.

Circle No. **9** *on Reply Card*



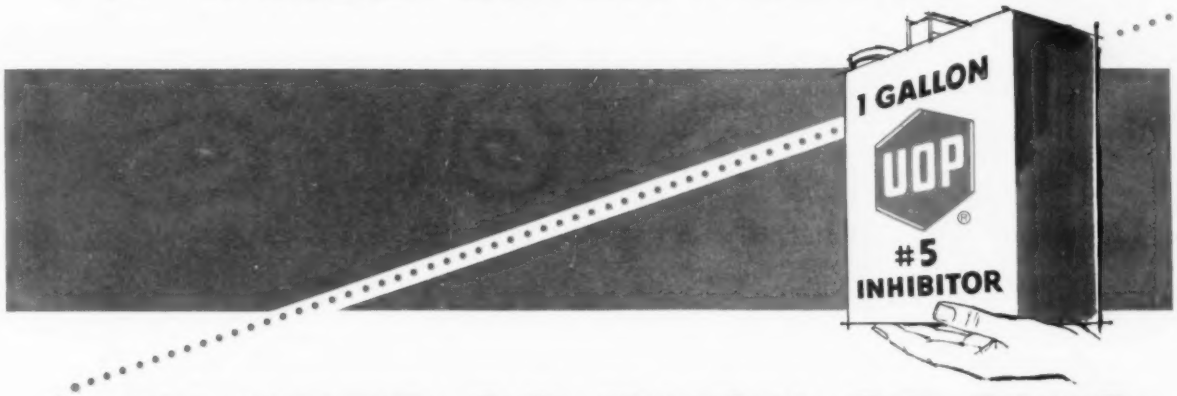
Condensation trap

. . . for vacuum manipulation of hydrocarbons and other volatile compounds has 50% greater cold surface than conventional traps of the same dimensions.

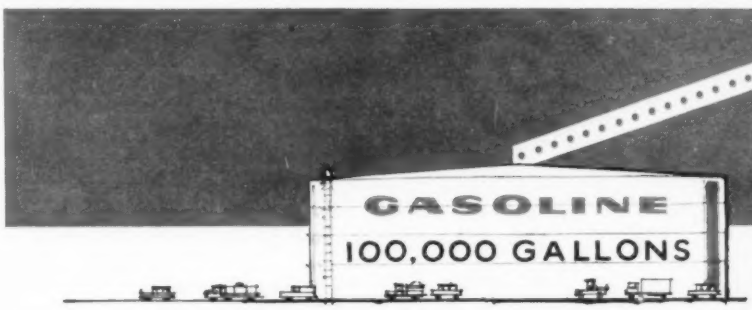
When the trap is immersed, coolant fills the inner glass spiral and surrounds the outer surface of the trap. The upper extension of the spiral is bent downward as a return for liquid nitrogen coolant which pumps back into the Dewar flask when the trap is first immersed.

Sizes of the all-glass trap are available to fit both pint and quart Dewar

* IT TAKES SO LITTLE OF THIS



* TO KEEP SO MUCH OF THIS



GUM-FREE

Even though UOP #5 Inhibitor is the most economical you can use (only 5 molecules of UOP #5 protect as many as 1,000,000 molecules of gasoline), it is also the only inhibitor that can handle the tough stability jobs.

The formation of gum in modern gasolines is the one universally recognized cause of engine manifold deposits. UOP Inhibitor #5 has been proven, by test and actual use, the best preventative for this. It's effective, too, in preventing the decomposition of TEL in stored gasolines.

UOP's technical staff has pioneered the development of techniques of finishing gasolines for maximum gum stability and engine cleanliness. Why not let us help you answer your stability problems more efficiently and at a lower cost?

UOP #5 is one of a number of UOP inhibitors and additives available to the refining industry. If you have a protection or preservation problem for product or transport facilities consult us.

PRODUCTS DEPARTMENT

UOP UNIVERSAL OIL PRODUCTS COMPANY

30 ALGONQUIN ROAD, DES PLAINES, ILLINOIS, U. S. A.

(To obtain more data on advertised products see page 170)

When it comes to an all-service compressed sheet for packing flanges and joints *it just doesn't pay* to take chances on unbranded or unknown materials. *It does pay* to cut your gaskets out of time-proved, widely known PALMETTO® SuperSheat.

Here's why:

PALMETTO SuperSheat has what it takes! Under rigid quality control it is constructed of selected, long-fibre asbestos, pressure-bonded with heat and chemical-resisting bonding materials . . . Compressible to meet flange surface irregularities . . . Resilient to allow for expansion and contraction . . . Homogenous to eliminate ply separation . . . Seals against oil, gas, steam, air and other chemical services. Meets MIL-A-17472, formerly U. S. Spec. 33-P-13d and Federal Spec. HH-P-0046.

PALMETTO SuperSheat is as near as your phone! Wherever you are there's a PALMETTO distributor nearby with a supply of SuperSheat in standard sheets up to 126" x 126". Don't risk buying "a pig in the poke", specify reputable, PALMETTO SuperSheat! See our insert in Thomas Register packing section for the name of distributor nearest you.

WRITE FOR BULLETIN SP-23

PALMETTO Packings

packing more performance into every application

GREENE, TWEED & CO. North Wales, Pennsylvania

HERE'S AN EASY WAY TO ORDER REPRINTS

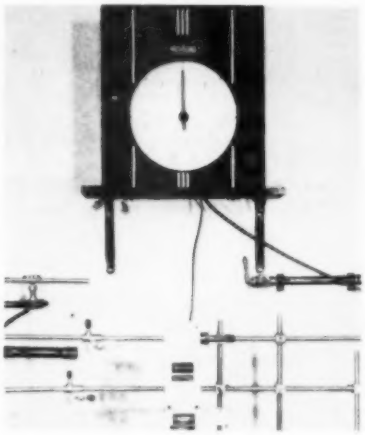
You can use the Reader's Service Card in this issue of PETROLEUM PROCESSING to order reprints. Here's how:

- Check the list of reprints on page 172.
- Circle the proper "R" letter on the Reader's Service Card (Area "C").
- Fill in your name and address—and send the card to us.

We'll bill you with the reprints

flasks, with larger sizes or special traps available on special order. The trap can be used as a vacuum system fore trap and as a collector in air pollution analyses. **California Scientific Glass Co.,** 35 S. Raymond Ave., Pasadena, Calif.

Circle No. **10** *on Reply Card*

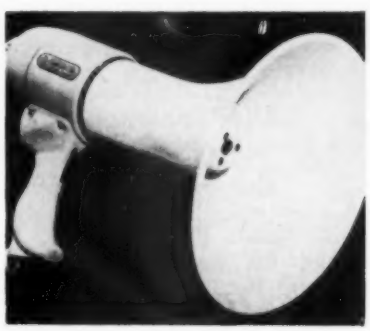


High pressure meter

. . . measures flow of liquids and gases at pressures up to 15,000 psi at 100°F.

The unit is designed for linear reading with the manufacturer's Actotran explosion-proof differential transformer and dial indicator. Three interchangeable stainless steel flow tubes permit up to 30 desired flow ranges, from 0.1 ml to 23 liters per minute. Interchangeable jackets can be obtained for hot fluids with working pressures from 50 to 1000 psi. **C-Mar Corporation,** 35 Euclid Ave., Manasquan, N.J.

Circle No. **11** *on Reply Card*



Electronic megaphone

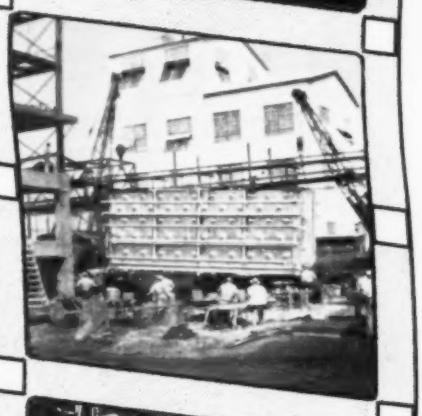
. . . weighs only five pounds and can be used over a range of ¼ mile.

With a power output of 3½ watts, the Pye Transhailer contains a speak-

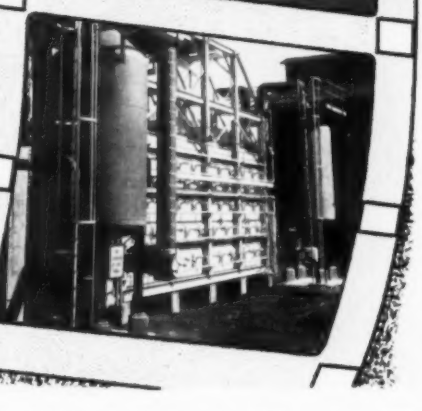
Selas prefabrication saves time and money at job-site

After final inspection, the completed Selas Gradiation Heater is securely anchored on flatcar for shipment. Stack and convection sections are in adjoining car.

Upon arrival at job-site, cranes allow flatcar to be slipped out, Lo Boy slipped in.



The heater is lowered onto prepared foundations.



Convection, and stack sections are installed; connection to process and fuel gas piping completes job.

SELAS prefabrication means much more than the accepted definition of prefabrication: *it is shop-assembly*. In capacities as large as 45 million Btu/hr coil duty, Selas Gradiation® Heaters are *complete* when they are shipped out: burners, brickwork, arch tiles are in place; manifold piping is attached and intact, complete with flanged connections; stacks and ducts completely insulated. Heating coils can be shipped installed or delivered to job-site, pre-assembled on tube supports, as desired.

In terms of field effort, Selas *shop-assembly* means complete erection of sub-assemblies on job-site foundations in less than eight hours!

Whatever your needs—*shop-assembly* or field-assembly—Selas Gradiation Heaters will give you longer "on-stream" periods, high conversions and selectivity, Zone Control of heat input, uniform heat distribution on the entire tube surface which extends tube life. Send for Bulletin 133 "Gradiation Heating for Petroleum and Chemical Processing."

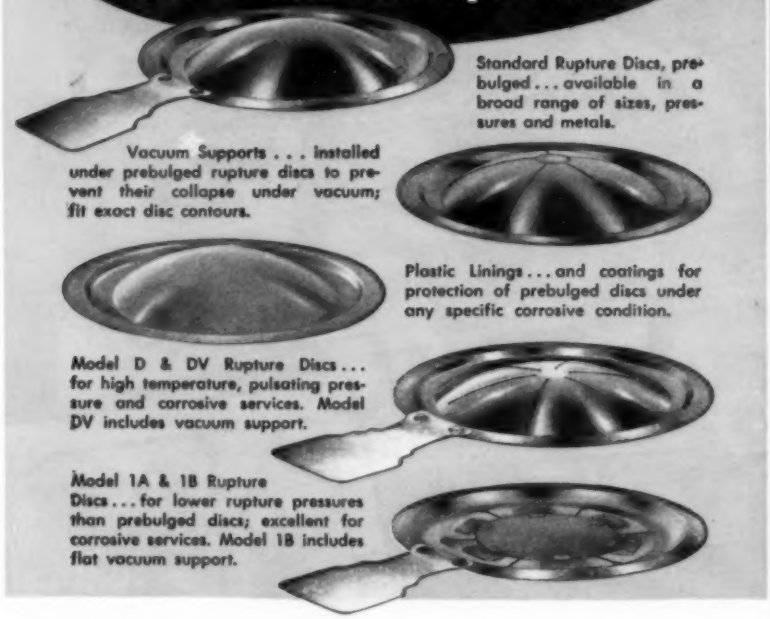
SELAS
CORPORATION OF AMERICA

DRESHER, PENNSYLVANIA

HEAT AND FLUID PROCESSING ENGINEERS
DEVELOPMENT . . . DESIGN . . . CONSTRUCTION

(To obtain more data on advertised products see page 170)

These BS&B Rupture Discs Can Give Your Pressured System...



Standard Rupture Discs, prebulged... available in a broad range of sizes, pressures and metals.

Vacuum Supports . . . installed under prebulged rupture discs to prevent their collapse under vacuum; fit exact disc contours.

Plastic Linings... and coatings for protection of prebulged discs under any specific corrosive condition.

Model D & DV Rupture Discs... for high temperature, pulsating pressure and corrosive services. Model DV includes vacuum support.

Model 1A & 1B Rupture Discs... for lower rupture pressures than prebulged discs; excellent for corrosive services. Model 1B includes flat vacuum support.

Positive Pressure Protection From 3 To 50,000 PSI

Installing a BS&B Rupture Disc on a pressured system provides protective insurance against a major disaster. Thousands of BS&B Safety Heads, each containing a BS&B Rupture Disc custom made to meet the individual requirements of the system it protects, are now guarding pressured systems in all types of industries.

Fully accepted by most local and national codes for use as either primary or secondary pressure relieving devices, BS&B Rupture Discs can be *your* positive and final measure of protection for the unexpected emergency.

BS&B Safety Heads

THE "CIRCUIT BREAKER" of Pressured Systems

Why not talk it over with your BS&B Representative... or write for further information to...

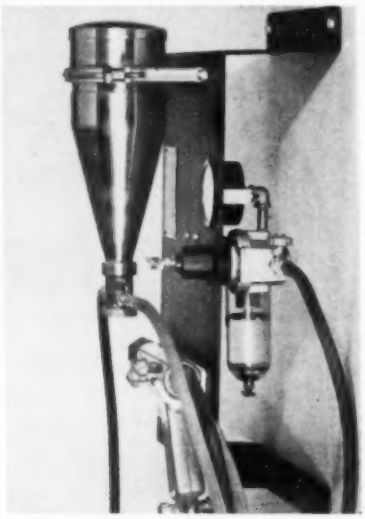
BLACK, SIVALLS & BRYSON, INC.

Safety Head Division, Dept. 2-D3
7500 East 12th Street
Kansas City 26, Missouri

er, amplifier, batteries and microphone in one weather-resistant housing. Germanium transistors in the amplifying circuit permit operation on standard flashlight batteries, with expected battery life of 12 hours when used every alternate 20 seconds.

The Transhailer can be used in ship-to-shore communications, within battery limits of refineries or other places where outdoor vocal communications are required at distances up to ¼ mile. **Pye Corporation of America**, 270 Park Ave., New York 17, N.Y.

Circle No. **12** *on Reply Card*



Metal Spray Unit

. . . **applies hard-facing powders** to steel of all kinds, including stainless. Higher rates and improved metal deposit efficiencies are possible with this new unit, Model C-2 spray welder.

Many metals can be applied including aluminum, zinc, copper, nickel, stainless steel, brass, lead or high temperature brazing alloys as powder.

The complete metal spraying unit includes a 3-lb aluminum pistol, a chromium plated hopper, carburetor, a new combination air regulator-filter, and hoses and fittings. The filter has a clear plastic bowl that permits inspection for dirt and moisture. **Wall Colmony Corp.**, 19345 John R St., Detroit 3, Mich.

Circle No. **13** *on Reply Card*

Gasket material

. . . **for high temperatures** is compounded of asbestos fibers and synthetic rubber. The material is tough, easily bent without cracking, and easily die-cut.

Made by a patented beater-satura-

(To obtain more data on advertised products see page 170)

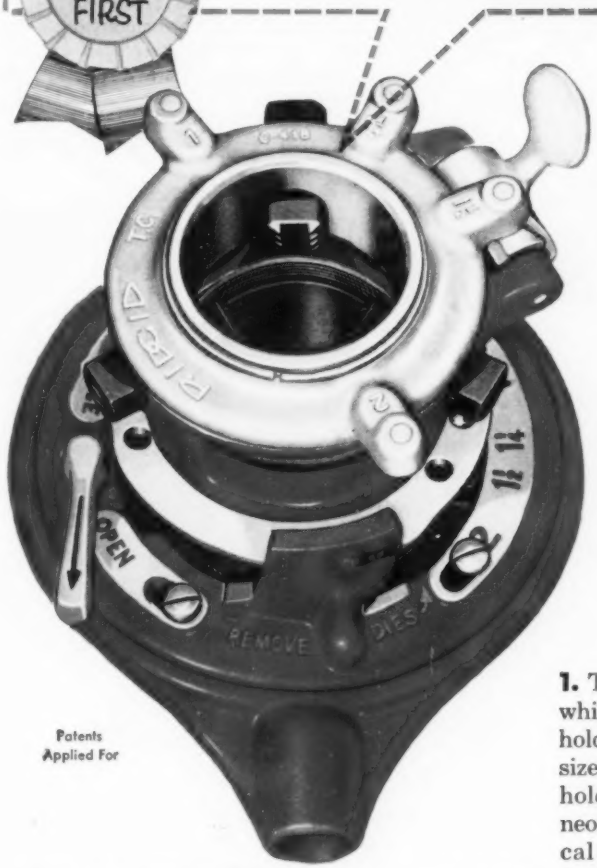
Big News!

RIDGID 65R

Now Has A Revolutionary New

True-Centering Workholder

Another RIDGID FIRST



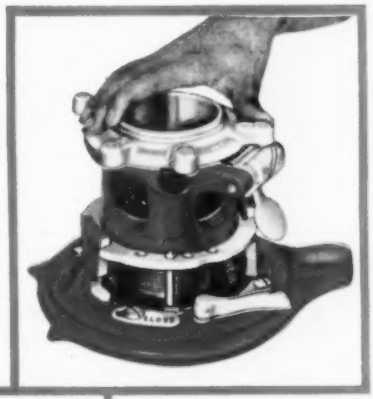
Patents Applied For

That Guarantees Always True Straight Threads

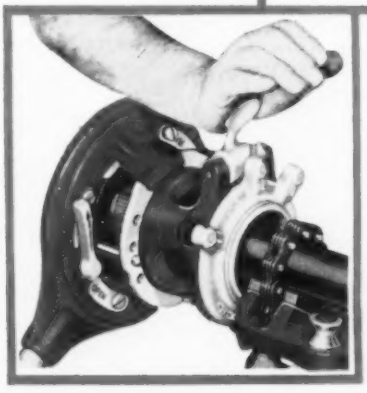
...even on over or under size pipe

Because All 3 Workholder Jaws Close At One Time!

Here's How It Works . . .



1. Turn cam plate which pre-sets workholder to desired pipe size, closes *all* 3 workholder jaws simultaneously by 1 mechanical action, for exact centering of die stock on pipe, even if pipe is over or under size.



2. When threader is on pipe, all 3 workholder jaws tighten in 1 action by bump of forged cam lever with palm of hand. Jaws grip and hold tight. Threads are *always* straight and true.

New TC Workholder fits your old 65R

. . . easy to change—ask your Supply House.

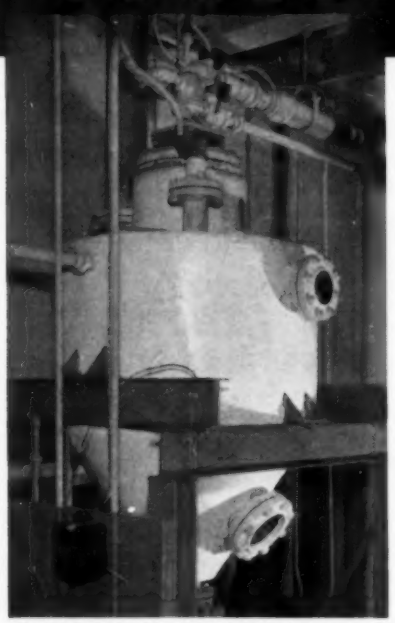
RIDGID 65R is jam-proof—kicks out automatically when standard thread is cut. Threads 1″ to 2″ pipe or conduit with 1 set of dies that stay in threader. Change from size to size in only 8 seconds. Instant workholder setting. With new TC workholder, 65R is far the most for your money—ask your Supply House today!

RIDGID
Work-Saver Pipe Tools

The Ridge Tool Company, Elyria, Ohio, U.S.A.

(To obtain more data on advertised products see page 170)

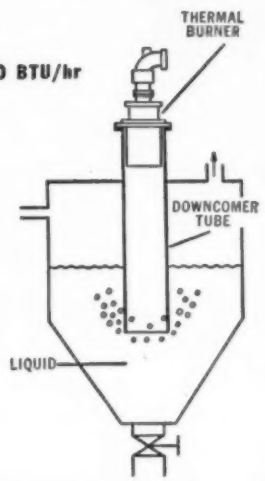
THERMAL
SUBMERGED
COMBUSTION



simplicity of design and construction... *plus* extreme compactness

HEAT INPUTS OF 250,000 BTU/hr to 5,000,000 BTU/hr

The high heat release rate of the THERMAL High Velocity burner used in these submerged combustion installations allows the use of a simple downcomer tube through which the products of combustion are discharged beneath the surface of the liquid. This arrangement is possible because combustion is 90% completed within the burner proper. The THERMAL burner is completely separate from the liquid being heated and maintenance, control and accessibility are greatly simplified. Equally simple arrangements are possible with gas, oil or combination fuel.



BROAD RANGE OF APPLICATIONS

Depending upon the material being heated either a metal or refractory downcomer tube may be used. Some of the more common applications are pickling baths, acid concentration, caustic soda concentration, aluminum sulphate concentration, water recarbonization, and glass frit and molten salt heating.

WRITE FOR BULLETIN #110

OTHER THERMAL PRODUCTS & SERVICES → Gas, Oil & Combination Burners • Air Heaters • Combustion & Heat Transfer Equipment

THERMAL
Thermal Research & Engineering Corp.
CONSHOHOCKEN • PENNSYLVANIA
REPRESENTATIVES IN PRINCIPAL CITIES

tion process (similar to paper making) sheets of the Accopac high temperature gasket material are quite flexible. Three types of synthetic rubbers are used to bind together the refined asbestos fibers: styrene, chloroprene, and nitrile-type synthetic rubbers.

Sealing performance is good with minimum bolt torque loss where flange temperatures are as high as 500°F, and internal liquid pressures are up to 500 psi. Per cent compressibility at 5000 psi varies between 30 and 40 (%). The material is available in rolls and sheets or die-cut parts. Gauge thicknesses are 1/64-, 1/32-, 3/64- and 1/16-in. **Armstrong Cork Co.,** Lancaster, Pa.

Circle No. **14** *on Reply Card*

Injection system

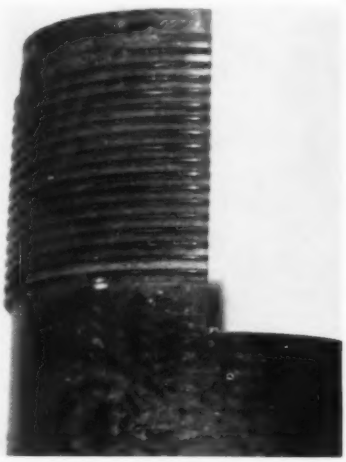
. . . for the Fisher-Gulf Partitioner permits accurate reproduction of chromatographic samples. Using the new pipets, an experienced operator can reproduce the volume of a 0.001-ml liquid sample within ±0.3% time after time.

Because of the increased accuracy of sample volumes, a control chemist can compare concentrations of key impurities from sample to sample by comparing the number of integrator "pips" under the peaks in which he is interested. With the volumes always the same, then the ratio of pips is equal to the ratio of concentrations.

The new injection system employs a self-sealing vestibule design worked

out in the Baton Rouge research laboratories of Esso Standard Oil Co., and which has been adapted to the Partitioner by **Fisher Scientific Co.**, 389 Fisher Building, Pittsburgh 19, Pa.

Circle No. **15** *on Reply Card*

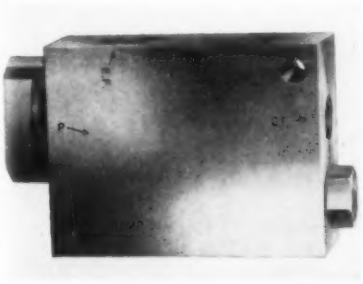


Non-metallic pipe

. . . has many of the advantages of both metal and extruded plastic pipe. It can operate from —65 to 260°F, is resistant to most corrosives, is a non-conductor, has light weight and high strength, and can operate in the pressure range of 300 to 1000 psi.

The pipe is made of a multiple layer of braided glass reinforcement and impregnated with cast epoxy. The threads are formed by upsetting and do not weaken the joints. All ends are coated with epoxy to protect against corrosion. Many fittings are available, including threaded nipples, elbows, flanges, couplings, tees and service saddles. **The Fibercast Corp.**, P.O. Box 727, Sand Springs (Tulsa), Okla.

Circle No. **16** *on Reply Card*



Flow divider

. . . separates a hydraulic force for two or more operations on hydraulically controlled machinery.

By adjustment with a simple screw-

THIS

"VALVE WITH A THOUSAND SEATS"

. . . increases

PUMP EFFICIENCY and PUMP CAPACITY

● Here's a revolutionary idea in pump valves that results in much longer, trouble-free valve life and greater pump capacity. The ROYAL CROWN PUMP VALVE has only three separate parts. Valve is guided by a frictionless ball stem (not a rigid guide) which allows it to oscillate and turn with the fluid stream. It swings freely with each stroke of the pump — seating perfectly each time in a new position. There is a minimum of resistance to the fluid, which results in greater pump volume at less pump speed. Royal Crown PUMP VALVES handle all types of liquids . . . are adaptable to all reciprocating pumps.

Royal Crown PUMP VALVES

(A) Round valve surface is streamlined. No obstructions to restrict the flow. (B) Ball-guided valve rotates and swings with each stroke of the pump. Each turn, each swing . . . a lapping action, a continuing perfect seat. (C) Free vertical action assures instant opening and closing. Ball stem is a frictionless guide.

BLH BALDWIN-LIMA-HAMILTON

MADSEN WORKS

BALDWIN-LIMA-HAMILTON CORPORATION

Construction Equipment Division

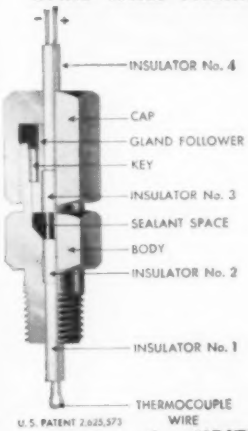
Write for details today

14120 E. ROSECRANS AVE. • P.O. BOX 38 • LA MIRADA, CALIFORNIA

FAST RESPONSE

conax®

BARE WIRE THERMOCOUPLE GLANDS



U.S. PATENT 2,625,573

Provide the only simple, positive method for sealing two or more bare wires at pressures from full vacuum to 20,000 psi.

Low mass, unshielded, bare wire thermocouples give almost instantaneous response to temperature changes assuring greater accuracy of measurement and control.

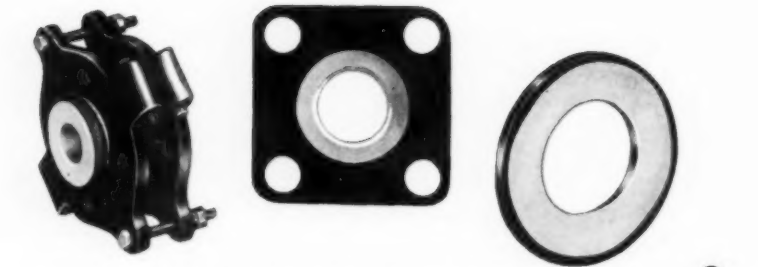
- Temperature range— −300° F to +1850°F
- All stainless steel construction
- Complete range of sizes
- Available from stock

WRITE FOR CONAX DATA BOOK SHOWING COMPLETE LINE OF THERMOCOUPLE ASSEMBLIES AND PRESSURE SEALING GLANDS.

conax CORPORATION

7823 Sheridan Drive, Buffalo 21, N. Y.

(To obtain more data on advertised products see page 170)



GASKETS

CUT TO SPECIFICATION

Any SIZE • SHAPE • MATERIAL • QUANTITY

for old or new equipment

Asbestos	Rubber	Neoprene
Hycar	Tygon	Teflon
Kel-F	Cork	Special

Teflon Expansion Joints

Write or call for prices

SENTINEL GLASS CO. SUNSET LANE • HATBORO, PA. OS 5-5700

ECLIPSE Ammonia and F-22 Compressors
Large ECLIPSE 9-Cyl Compressor
"ECLIPSE" Compressors, 2, 3, 4, 6 or 9 Cylinders
Small Ammonia & Freon-22 Compressors
"ECLIPSE" Low Pressure Units in 5 Sizes
Accessible-Hermetic Units, ¼ thru 7½ Hp
Open-drive Low Pressure Units, ¼ to 15 Hp
Booster Compressors for Low Temperatures
Combined Ammonia Units 3 Sizes
Large 2-Cyl Ammonia Compressors
Large 4-Cylinder Compressors—Up to 700 Hp
83 TYPES AND SIZES OF
FRICK
REFRIGERATING MACHINES
Most comprehensive line of compressors in the industry. There's one to meet the needs of your business exactly. Handle any commercial or industrial load, at any temperature, with any refrigerant! Get the full facts and figures now: write, wire or phone
DEPENDABLE REFRIGERATION SINCE 1882
FRICK CO.
WAYNESBORO, PENNA. U.S.A.

driver, the flow divider can control the flow over a range from 10% to 95%, as the circuit may require. When the pressure in the primary operations begins to build up, the flow to the secondary operations will decrease. A built-in relief valve passes the oil back to the sump when the peak pressure setting of the secondary flow is reached. **New Products Corp.,** 3636 Oakton St., Skokie, Ill.

Circle No. **17** *on Reply Card*

Corrosion Resistant Liner

. . . **made of an easily applied** epoxy base compound and glass cloth requires no high temperature curing because the plastic hardens in 24 hours at ambient temperatures.

Called Coroline 347, the new plastic is inert to organic acids, dilute mineral acids, caustics, and most solvents. It is especially recommended by the manufacturer for use with petroleum products. The plastic is actually composed of two parts, easily mixed at application time. It can be either sprayed or brushed on, and used in applying other fabrics besides glass cloth.

Successive applications can be made immediately when required. With excellent adhesion qualities claimed, the plastic can be applied easily on complex surfaces. The coatings can be checked by high voltage spark testing for good coverage. **Homalite Corp.,** 11-13 Brookside Drive, Wilmington 4, Del.

Circle No. **18** *on Reply Card*

Titanium trichloride

. . . **is now available** in commercial quantities up to hundreds of pounds. Previously it was obtainable only in ounce or gram amounts for research purposes.

This fine, dark purple, crystalline

you can meet any lubrication standard if you

BLEND WITH ENJAY PARATONE®

(VISCOSITY-INDEX IMPROVERS)

Base stocks blended with Enjay Paratone can be compounded into lubricants combining cold-weather quick starting properties with high temperature, low consumption characteristics. These lubricants are *all-season* oils, featuring improved gas mileage. More and more refiners and blenders are relying exclusively on Paratone to produce the high "VI" required in these all-season oils.

Through years of intensive research and development work with automotive manufacturers, Enjay has developed the only *complete line* of high quality additives (Paramins®) that can assure *maximum* performance characteristics. Why not let this experience and know-how work for *you*? Write, wire or phone the Enjay Company today.

ENJAY

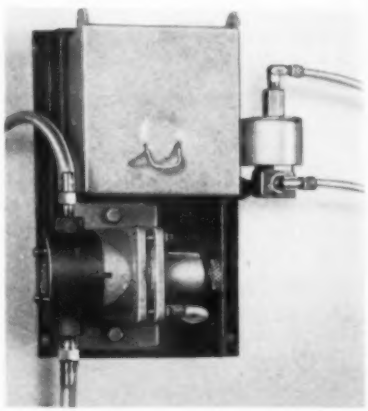
Pioneer in Petrochemicals

ENJAY COMPANY, INC., 15 WEST 51st ST., NEW YORK 19, N. Y.

Akron • Boston • Chicago • Los Angeles • New Orleans • Tulsa

powder is attracting a great deal of attention as a potential catalyst for the manufacture of isotactic polymers such as polypropylene, polybutene and polystyrene. It is also considered a promising catalyst for Ziegler low pressure polyethylene, of new cis-polybutadine rubber, and for use in Friedel-Crafts type reactions. **Stauffer Chemical Co.,** 380 Madison Ave., New York 17, N.Y.

Circle No. **19** *on Reply Card*



Diaphragm feeder

. . . for concentrated chemicals can be hung on the wall and can handle chemicals directly from the shipping container.

Model 19130 Proportioner costs less than similar units, according to the manufacturer, and is constructed to handle small quantities of the most corrosive solutions. Pumping rates vary from 0.8 to 8.0 gal/24 hr, and can be adjusted by varying stroke length and stroking frequencies. Accuracy is within plus or minus 5% over a 5 to 1 range. **Proportioneers, Inc.,** 345 Harris Ave., Providence, R.I.

Circle No. **20** *on Reply Card*

Cooling water calculator

. . . solves problems of makeup and corrosion inhibitor addition for those operating cooling water towers.

This handy, special slide rule will handle three types of problems: (1) determining make up rate for various recirculation rates, concentration cycles, and temperature drops; (2) calculating inhibitor additions for different concentration cycles and ppm concentrations; and (3) figuring inhibitor addition for a single charge.

Although the plastic calculator normally sells for $2.00, it will be sent with no obligation to chief engineers,

like a trained seal . . .

metallo gaskets

. . . serve you best!

Serving The Processing, Power and Heat Transfer Equipment Industries for over 37 years with skilled craftsmanship backed up by complete, modern equipment for the manufacture, inspection and shipment of outstanding Metallo Gaskets.

Standard Type Gaskets Available For Immediate Delivery from our vast and varied inventory. Write for our complete catalog containing detailed specifications and style numbers. No cost or obligation!

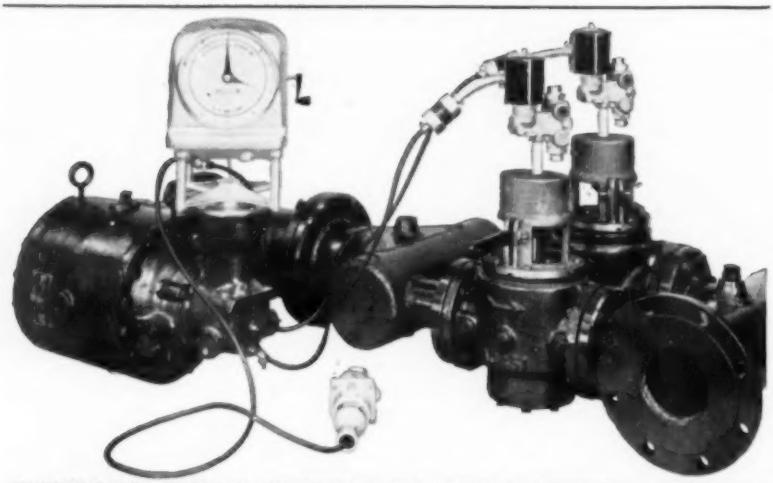
Special Type Gaskets Fabricated To Order for fast delivery anywhere. We supply gaskets for heat exchangers and similar equipment to your most exacting requirements. Write for details.

from pipe joints to packed towers . . . if it's gaskets or metal tower packing . . . CONTACT

metallo gasket co.

20 BETHANY ST. • NEW BRUNSWICK, N. J.

Metal and Metal Asbestos Gaskets • Heat Exchanger Gaskets • Metal Stampings • Raschig Rings • Lessig Rings



TYPICAL DUAL-VALVE FLUIDOMETER SYSTEM

for greater accuracy in handling large flow rates in either jacketed or unjacketed systems

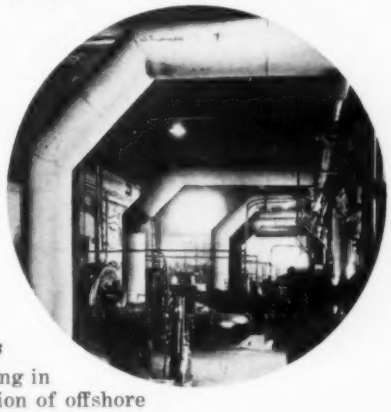
Dual valve Fluidometer Systems insure maximum accuracy in handling large flow rates. The dual valve system also reduces line shock, thereby keeping maintenance to a minimum. In this type of installation the Fluidometer System is so arranged that the liquid flows through both valves. The large valve shuts off before delivery is complete, reducing the flow rate. The control head controls both valves—staggering the closure to insure greater accuracy. New Bulletin Fl-56 will be sent on request.

For information on jacketed pipe and fittings write for Bulletin J-56.

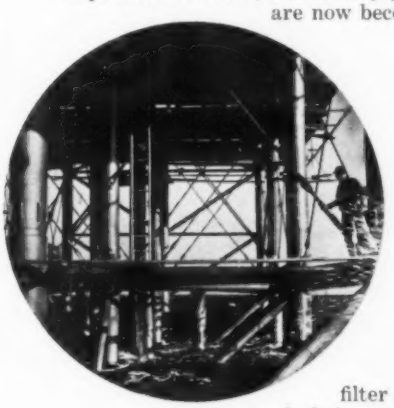
HETHERINGTON & BERNER INC. • 715 Kentucky Ave., Indianapolis 7, Ind.

How Monel pays off in equipment exposed to salt solutions

. . . pays off in pumps At Caloil's Perth Amboy refinery, this pump supplies 40,000 GPM of brackish cooling water. To counter the severe corrosive and erosive conditions, its shaft sleeves and 2200-lb. impeller are Monel* nickel-copper alloy. Monel alloy is a money-saver in seawater pumps.

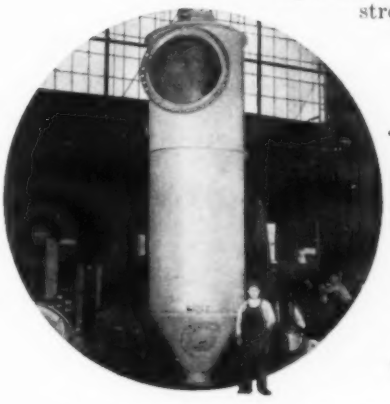


pays off in piping . . .
In this California refinery, light-weight Monel lines proved able to handle salt water years longer than cast iron. This experience has been duplicated so often, Monel alloy piping, fittings, and valves are now becoming standard for such service.



. . . pays off in structurals
The value of Monel alloy sheathing in preventing splash-zone corrosion of offshore structures like this is well-known. A less spectacular but equally valuable use is for plant structurals subject to salt splash, spill or atmospheres . . . tank supports, for example, or just plain nuts and bolts.

pays off in process vessels . . .
These Sharples Super-D-Hydrators filter sodium sulfate crystals, wash them in brine and then dry them. Monel alloy provides just the needed properties for parts . . . . top-notch resistance to both corrosives, strength to handle high centrifugal forces, excellent fabricability.



. . . pays off in heat exchangers, condensers
This barometric condenser is now in service at a large eastern sugar refinery. It features a Monel Clad Steel shell and solid Monel alloy internals. This construction has proved so effective in resisting the corrosive attack of brackish bay water that the refinery has standardized on Monel.

If your equipment for handling seawater and salt solutions is deteriorating faster than it should, an evaluation of Monel alloy in the application may prove helpful. Write Inco's Development and Research Division. *Registered trademark

THE INTERNATIONAL NICKEL COMPANY, INC., 67 Wall Street, New York 5, N.Y.

INCO TRADE MARK Nickel Alloys

Monel ... ***for minimum maintenance***

(To obtain more data on advertised products see page 170)

TOUGH GRINDING MADE EASY...

Clean up castings and welds . . . deburr or do any portable snagging or grinding job faster and easier with this new Airetool grinder. It's light, rugged, easy-to-handle . . . packs plenty of power and speed — won't stall or heat-up under severe loads. Precision built Airetool air motor provides major operating economies and maintenance free service under constant work load.

MODEL 700

Smooth, balanced design and light 12 lb. weight makes maneuvering easy. Control button operates speed up to 6000 RPM. Lever control valve also available.

NEW

air-motor

AIRETOOL GRINDERS

ABRASIVE BELT ATTACHMENT fits model 700 grinder. Ideal for fine finishing operations on dies, molds, seam welds or any contour surface.

RIGHT-ANGLE GRINDER Model 700A offers maximum convenience and working efficiency when grinding or sanding flat or curved surfaces.

Contact your AIRETOOL representative or write for Bulletin No. 61

AIRETOOL
MANUFACTURING COMPANY
SPRINGFIELD, OHIO

BRANCH OFFICES: New York, Chicago, Tulsa, Philadelphia, Houston, Baton Rouge

REPRESENTATIVES: in principal cities of U.S.A., Canada, Mexico, South America, England, Europe, Puerto Rico, Italy, Japan, Hawaii

EUROPEAN PLANT: Vlaardingen, The Netherlands

CANADIAN PLANT: 37 Spalding Drive, Brantford, Ontario.

plant superintendents and other persons responsible for the control of scale, corrosion, slime and algae in cooling systems. Requests should be on company stationery and sent to **Wright Chemical Corporation,** 627 W. Lake St., Chicago 6, Ill.

Do not use Reply Card

Ducts and Hoods

. . . **for corrosive conditions** are made of glass fibres and a corrosion resistant plastic.

Fabricated of a thermo-setting plastic material and a fabric base, these hoods and ducts combine chemical resistance, light weight, strength, and easy design. The material resists acids, including hydrofluoric, as well as alkalis and solvents. These Duracor materials range from 11,000 to 15,000 psi in tensile strength, and from 22,000 to 30,000 psi in flexural strength.

Fabricated tank hoods and ducts can be produced to almost any desired shape. Mounting is simplified because of the lightweight of the completed unit. **Ceilcote Co.,** Inc., 4911 Ridge Road, Cleveland 9, Ohio.

Circle No. **21** *on Reply Card*

Free Trade Literature

Petroleum Processing index

. . . for 1956: includes subject and author indexes for all feature articles and regular departments published during the past year. Available from McGraw-Hill Petroleum Publications, 330 West 42nd St., New York 36, N.Y.

Circle No. **100** *on Reply Card*

Tool steels

. . . cataloged by AISI-SAE designations but cross-referenced by brand name: this is the information available

Loren Farris
PERSONNEL DIRECTOR
Detroit Division
Chicago Rawhide Manufacturing Co.

"Look! It soaks up grease just like a sponge."

LAN-O-KLEEN removes 95% of all dirt and grime encountered in industry.

Easily — and safely!

LAN-O-KLEEN helps to protect the skin as it cleans. WEST — in pioneering the development of "double action" industrial cleaners — was the first to impregnate beneficial amounts of free lanolin into a corn meal type hand cleaner.

LAN-O-KLEEN is economical to use. It bulks greater than most other hand cleaners — therefore goes farther per pound. Too, the sturdy LAN-O-KLEEN dispenser rations just the right amount to do a quick, thorough cleansing job.

"We know of no safer hand cleaner than Lan-O-Kleen"

"We've always been interested in preventing dermatitis. This is why we've supplied our plant employees with Lan-O-Kleen for the past ten years. Its free lanolin and soft cleansing action help prevent skin irritations, yet quickly remove dirt, grease and grime," says LOREN FARRIS, Personnel Director, Detroit Division of Chicago Rawhide Manufacturing Company.

"Several of our departments have also used West Antiseptic Protective Hand Creams for a number of years. We know these aids to comfort and safety help keep our workers on the job at maximum efficiency."

Would similar results interest you? Send the coupon.

LARGEST COMPANY OF ITS KIND IN THE WORLD

WEST DISINFECTING Company

WEST DISINFECTING COMPANY, 42-16 West Street, Long Island City 1, N. Y.
Branches in principal cities • In Canada: 5621-23 Casgrain Avenue, Montreal

☐ Please send your 24 page booklet "The Control of Dermatitis in Industry."
☐ Please have a West representative telephone for an appointment.

Name .....

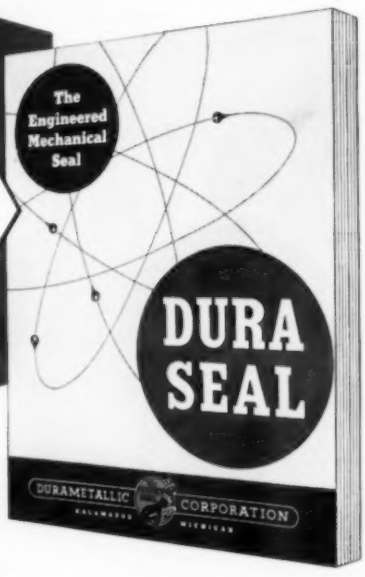
Position .....

Mail this coupon with your letterhead to Dept. 25

(To obtain more data on advertised products see page 170)

JUST OFF THE PRESS!

Send for This New Book on Mechanical Sealing



A Valuable Reference for Maintenance Engineers and Original Equipment Designers

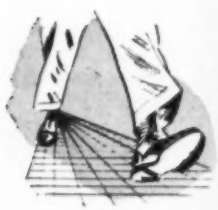
The most complete and helpful guide ever published by the originators of mechanical sealing for processing equipment—it illustrates and describes types of Dura Seals engineered to meet your specific temperature, pressure and fluid conditions.

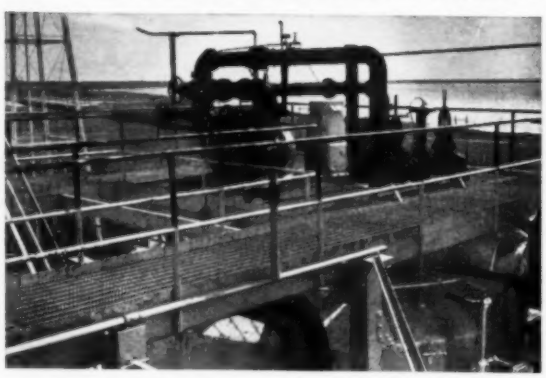
TO RECEIVE YOUR FREE COPY

simply send today for the new Dura Seal Catalog No. 480 to:

DURAMETALLIC CORPORATION
DEPT. 480-PP • KALAMAZOO, MICHIGAN

WHERE SURE FOOTEDNESS COUNTS





Gary

STEEL GRATING MAKES WALKS SAFER

Sturdy, one-piece construction with tops of all bars flush provides open steel flooring and stairs for safe, easier walking. Gary Grating is furnished in a wide variety of neat appearing designs and sizes—and is tailor-made to fit your needs. For complete description and installation pictures on Gary Welded Grating, Stair Treads and Gary-Irving Decking, ask for Catalog PP-37.

FREE SAMPLE
We'll send this handy paper weight if you request it on your company stationery.

ROCKWELL SPRING & AXLE CO.
Standard Steel Spring Division
4016 EAST SEVENTH AVE., GARY, INDIANA

What's New

in the 52-page *Burke Steel Catalog*. Listed in the catalog are brand names of major tool steel manufacturers, as well as industrial and government specifications. Each tool steel is described by analysis, heat-treatment, machinability, advantages and uses. Hardness values after various tempering temperatures are also included for many of the steels. Burke Steel Co., 30 Sherer St., Rochester 2, N.Y.

Circle No. **22** *on Reply Card*

Fin-tube heat exchangers

. . . are available in a wide variety of metallurgies: *Bulletin FH-3* lists the many types which are available with longitudinal, integral fins. They are built in standard sizes to facilitate series-parallel combinations for special applications, but also permit disassembly and setup for another use. Included in the bulletin are two data charts of finside coefficient and pressure drop. Alco Products, Inc., 30 Church St., New York 8, N.Y.

Circle No. **23** *on Reply Card*

Arc welding machines

. . . and accessories: *Catalog 1340, Form ADC 708C* is a 44-page review of the types of welding machines available from this company. Included are descriptions and classifications of selenium rectifiers and dc motor generators for industry, ac and dc engine driven welders for construction and maintenance, and ac transformer welders for miscellaneous jobs. Air Reduction Company, Inc., 150 East 42nd St., New York 17, N.Y.

Circle No. **24** *on Reply Card*

Rust-resistant coatings

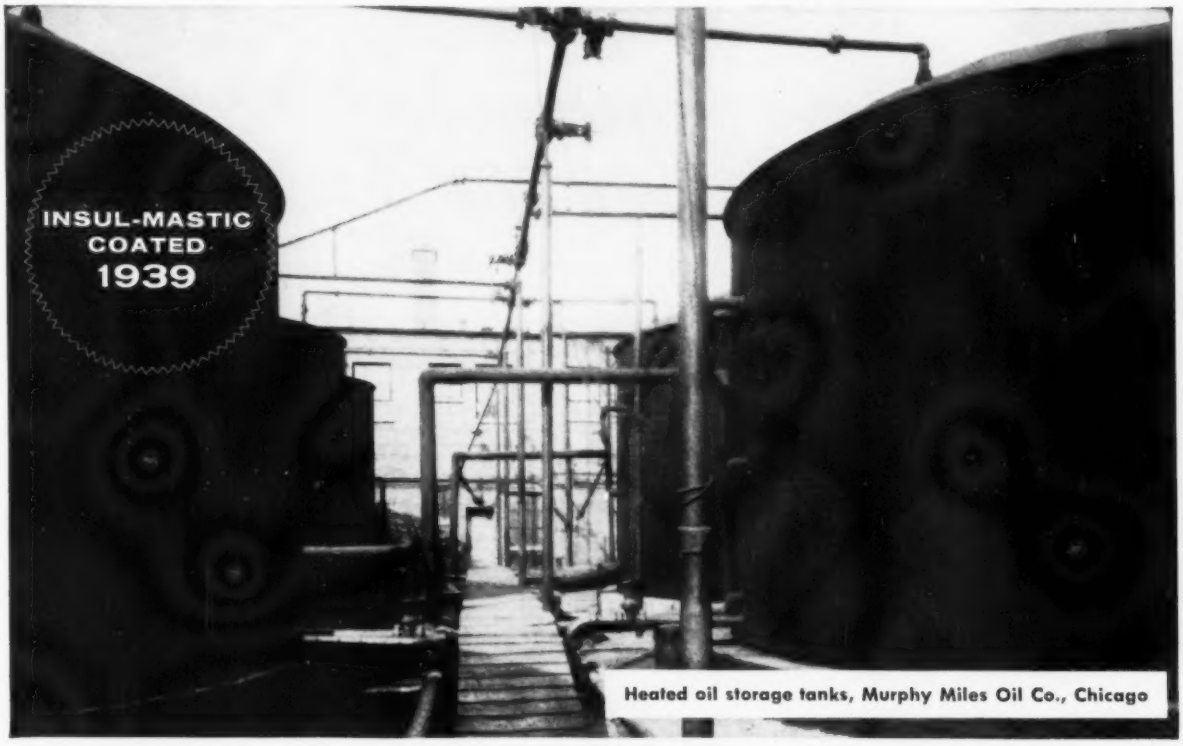
. . . for a wide range of applications: *Form No. 256* is a 32-page, full color manual that lists rust-resistant coatings for machinery, piping, concrete, tanks, hot equipment and chemical atmospheres. Color chips of all finishes are included, as well as directions for preparing the surfaces, and thinning and mixing the product. Rust-Oleum Corporation, 2799 Oakton St., Evanston, Ill.

Circle No. **25** *on Reply Card*

Mineral wool insulation

. . . has many applications which are listed in the catalog *Industrial Insulations*. More than 20 types of heat and cold insulation for equipment and piping are described. Included are lists of standard sizes, thicknesses, thermal conductivities, and suggested methods for applying these spun min-

Proof again—the best costs you less!

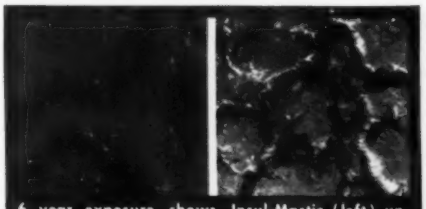


Heated oil storage tanks, Murphy Miles Oil Co., Chicago

17 Years without maintenance for these *Insul-Mastic* coated tanks

Ordinary asphaltic coatings can't possibly stand the test of years like Insul-Mastic "Gilsonite" coatings — and you can't ever be sure ordinary coatings are protecting against metal damage, or merely hiding it.

Understandably, Insul-Mastic costs a little more initially, but you can't find a better system for preventing corrosion, sealing out moisture, vapor sealing or handling the many specialized insulating requirements of industry. The proof is in the hundreds of installations like Murphy Miles Oil Co. where Insul-Mastic coatings continue to give the same *complete* protection they gave back in 1939. Your Insul-Mastic Representative will provide complete details without obligation.



6 year exposure shows Insul-Mastic (left) unchanged. Ordinary mastic (right) shows shrinkage and deterioration that breeds metal damage.

GILSONITE
makes the difference

Gilsonite is one of the most resistant of all materials used for protective coatings. It is composed of highly complex hydrocarbons saturated to the limit of their capacity, not susceptible to displacement by other elements nor to combination with acids and alkalis, nor to oxidation for many years by exposure to the atmosphere. It is better than 99.5% pure, being entirely free from volatiles and other short-lived impurities. *For years Insul-Mastic Gilsonite content has been far greater than any other mastic. Many contain no Gilsonite!*

MAIL THIS COUPON TODAY TO:
INSUL-MASTIC CORPORATION OF AMERICA
7752 West 61st Place, Summit, Illinois

☐ Send information ☐ Have Representative call

Name_____ Title_____

Company_____

Address_____

City_____ State_____

Think first of the coatings that last!

Insul-Mastic
CORPORATION OF AMERICA
7752 WEST 61st PLACE SUMMIT, ILLINOIS

HOW! PUMP USERS!

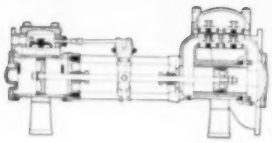
Go Modern... Go 3500 RPM

● Where *Overall Specific Speed* indicates, take advantage of the lower costs that go with modern, high speed centrifugal pumps. For any given condition, the higher the rotating speed, the smaller the pump, and the smaller the driver.

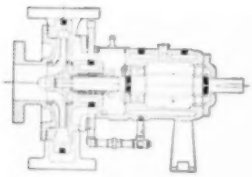
WARNING! High speeds require mechanical reliability. Dean Brothers standard centrifugal pumps are designed for 3500 RPM.

The Best is our Standard

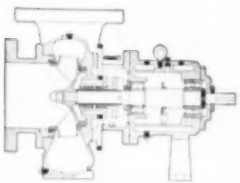
A WIDE RANGE OF OVERALL SPECIFIC SPEEDS IS COVERED BY THESE DEAN BROTHERS PUMPS



RECIPROCATING TYPE
Low Capacities and High Heads.
Indicated for Overall Specific Speeds of less than 500.



CENTRIFUGAL TYPE
Medium Capacities and Moderate Heads.
Indicated for Overall Specific Speeds from 500 to 3500.



MIXED FLOW TYPE
High Capacities and Low Heads.
Indicated for Overall Specific Speeds from 3500 to 5000.

OVERALL SPECIFIC SPEED

$$N_S = N\sqrt{Q/H^{3/2}}$$

N_s = Overall Specific Speed
N = Pump Rotative Speed
Q = Pump Capacity—gpm
H = Head—ft.

● If you would like to know how *Overall Specific Speed* can help you select the proper pump, write us or call your local Dean Brothers representative.

DEAN BROTHERS PUMPS INC.
EST. 1869
• 323 West 10th St., Indianapolis 7, Ind.

eral wool products. Baldwin-Hill Co., 500 Breunig Ave., Trenton 2, N.J.

Circle No. **26** *on Reply Card*

Storage tanks

. . . for many uses: *Graver Standard Storage Tanks* is a 20-page booklet showing the wide range of tanks and vessels which can be obtained from this company. Included is a table of dimensions for standard welded tanks of from 20- to 200-ft diameters. Graver Tank & Manufacturing Co., Inc., East Chicago, Ind.

Circle No. **27** *on Reply Card*

B.S.&W. monitor

. . . measures and controls the basic sediment and water content of crude oil in automatic custody transfer. A bulletin of the above title describes the instrument which was developed and patented by Gulf Research and Development Co., and which is now being manufactured by Instruments, Inc., 122 North Madison, Tulsa, Okla.

Circle No. **28** *on Reply Card*

A writing galvanometer

. . . that converts and records changing curvilinear motion to true rectilinear motion: *Bulletin R-501* describes the "recti/riter" that inscribes a milliameter signal that can be measured directly with a ruler. A supplementary bulletin describes a line voltage monitor that converts the recti/riter into an expanded scale graphic voltmeter for direct rectilinear recording of 115-volt 60 cps line voltage variations. Houston Technical Laboratories, 3609 Buffalo Speedway, Houston 6, Texas.

Circle No. **29** *on Reply Card*

Pourous media

. . . for gas diffusion and liquid filtration: *Form ESA-267* describes the physical and chemical properties of a fused crystalline aluminum oxide abrasive that is treated to form a porous product. Called Borolon, it has high strength and chemical resistance. Pore size and volume of the fabricated shapes can be closely controlled. Simonds Abrasive Co., Tacony & Fraley Streets, Philadelphia 37, Pa.

Circle No. **30** *on Reply Card*

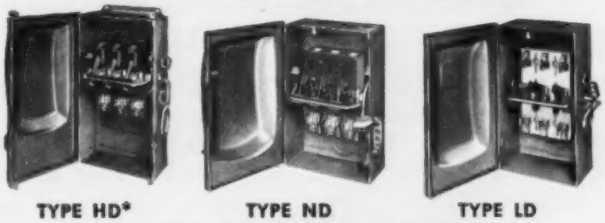
Ethylene oxide

. . . produced by the direct oxidation of ethylene: the subject of a brochure, which is complete with a flow diagram and technical history of the process. This product, ethylene oxide, is finding increasing use as a chemical

FIRST with a COMPLETE LINE OF SAFETY SWITCHES to meet the NEW NEMA STANDARDS

• The table below shows Square D switches meeting new industry specifications. Notice how they clarify conflicting features which existed under old designations. Notice, too, that they establish a new, heavy-duty industrial switch, Type HD.

One important thing which remains unchanged is the **DESIGN LEADERSHIP** which has made **SQUARE D SAFETY SWITCHES** an overwhelming **FIRST** choice in the petroleum and chemical industries for more than fifty years.



TYPE HD* **TYPE ND** **TYPE LD**

Available in NEMA 12, NEMA 4, 5, 7 and 9 Enclosures

DESCRIPTION	HEAVY DUTY New	NORMAL DUTY formerly Types H, S, or A	LIGHT DUTY formerly Types D or G
Rating-Ampere Voltage	30—600 250 or 600V AC, DC	30—1200 250 or 600V AC, DC	30—200 250V AC
Enclosure	NEMA 12 • Industrial Use (Gasketed) NEMA 4 & 5 • Water-tight & Dust-tight NEMA 7 • Explosion-resisting Class I—Group D NEMA 9 • Explosion-resisting	NEMA 1 • General Purpose NEMA 3R • Raintight	NEMA 1 • General Purpose NEMA 3R • Raintight
Horsepower Rating	NEC Fuse Ratings Dual-Element Fuse Ratings	NEC Fuse Rating Dual-Element Fuse Ratings	NEC Fuse Rating
Operating Mechanism	Quick-Make, Quick-Break Independent of Handle	Quick-Make, Quick-Break Independent of Handle	Positive Make, Positive Break Spring Assisted
Cover	Interlocked & Padlock Attachment	Interlocked & Padlock Attachment	Padlock Attachment
Plating—Current Parts	Extra-Heavy Silver	Silver	
Endurance	Maximum Endurance Far Exceeds UL Standards	Exceeds UL Standards	Meets UL Standards

NOW...EC&M PRODUCTS ARE A PART OF THE SQUARE D LINE!

SQUARE D COMPANY

 (To obtain more data on advertised products see page 170)

Photo—Courtesy of Barrett Division—Allied Chemical and Dye Corporation

GOOD MANAGEMENT Recognizes the Value of GOOD TANK EQUIPMENT

A glance at the above photo of the Philadelphia plant of the Barrett Division of the Allied Chemical & Dye Corporation reveals dozens of storage tanks equipped with "Varec" Conservation Vent Units, Pressure and Vacuum Relief Manhole Covers, and Automatic Tank Gauges.

Here is practical evidence of the important role "Varec" storage tank equipment plays in the industrial scene. "Varec" Figure No. 5800 Series Conservation Vent Unit affords the greatest protection for venting inflammable liquid storage. Flame Arrester, Figure No. 50, is listed by Underwriters' Laboratories for use on oil storage tanks and approved by Associated Factory Mutual Laboratories for use on chemical storage.

"Varec" Figure No. 2500 Series, Automatic Tank Gauge, furnishes accurate liquid level gauging to plus or minus ⅛ inch. These gauges can be mounted with "Varec" PULSE CODE Transmitters to convert to a "Varec" PULSE CODE Telemetering System. This provides for remoting liquid level, temperature, motor valve or other equipment status, abnormal or alarm conditions and other data as required. Contactor units to supply "on - off" remote control of equipment such as pumps, motor-driven valves, etc., are available.

If your problem concerns the safety or control of your process, you can profit by sending for "Varec" P-7R Catalog.

"Varec"

THE VAPOR RECOVERY SYSTEMS COMPANY
2820 North Alameda Street
Compton, California

Cable Address:
Varec Compton California (U.S.A.) All Codes

961-19

derivative although its principal use still is in the manufacture of ethylene glycol. Scientific Design Co., Inc., 2 Park Ave., New York 16, N.Y.

Circle No. **31** *on Reply Card*

Pyrometer indicator

. . . weighs less than 4 lb and is a dual purpose instrument. It can be used to measure temperature directly when connected to a thermocouple, or as a standard comparison instrument for checking other millivoltmeter and potentiometer-type instruments. *Bulletin No. 64* describes the "MiniMite," which has an accuracy of ¼% of scale range. Fifteen standard, double-range scales are available. Thermo Electric Co., Inc., Saddle Brook, N.J.

Circle No. **32** *on Reply Card*

Instruments

. . . for process control: *Catalog 2* describes the many types of control instruments which can be ordered for immediate shipment from this manufacturer. Flowrators, specific gravity testers, pressure regulators, controllers, recorders, and pressure indicators and transmitters are described. Two sizing nomographs for liquid and gas service flowrators are included in the catalog. Fischer & Porter Co., Hatboro, Pa.

Circle No. **33** *on Reply Card*

Rotameters

. . . and how to select the proper size for liquid or gas service: *Bulletin 18RG* includes this information as well as the history of this type of flow measuring device. Construction advantages of the manufacturer's Series 18200 "Safeguard" rotameters are also listed in the bulletin. Schutte and Koerting Co., Dept. M-E, Cornwells Heights, Bucks County, Pa.

Circle No. **34** *on Reply Card*

Molybdenum disulfide

. . . and its many properties: *Bulletin Cdb-5* covers the physical, thermodynamic, electrical and magnetic, and the chemical properties of this dry lubricant. Described are some of the lubricating as well as the catalytic uses for this refined mineral. Climax Molybdenum Co., 500 Fifth Ave., New York 36, N.Y.

Circle No. **35** *on Reply Card*

Engineering manual

. . . for clutches and clutch-couplings: *Engineering Manual Number 56* is a 78-page booklet that will aid

(To obtain more data on advertised products see page 170)

When Specs Demand Job Matched Piping and Fittings One Call Will Do it All—B&W

The layout has been made. Erection schedules are in the planning stage. What you do now in contacting a source of supply for your alloy steel pipe fittings and flanges, can very well be one of your most important moves.

If you call on B&W, you can be assured of benefits that simplify scheduling problems. With one call to B&W—on one order—you can obtain matched pipe, fittings and flanges to meet your specific requirements. What's more—the delivery of the alloy steel pipe, the seamless welding fittings, and the forged steel flanges that make up the integrated system you desire—can be coordinated. This is just one more reason why B&W has earned the reputation and acceptance as "the natural source" for alloy pipe and fittings.

Call on Mr. Tubes at your nearby B&W Tubular Products Division District Sales Office—let him coordinate your alloy steel pipe, seamless welding fittings and forged steel flange problems. He can help you. The Babcock & Wilcox Company, Tubular Products Division, Beaver Falls, Pa.

Seamless and welded tubular products, seamless welding fittings and forged steel flanges—in carbon, alloy and stainless steel.

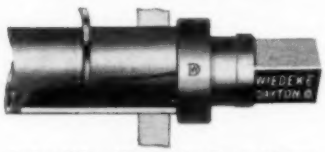
WIEDEKE

THE QUALITY NAME IN TUBE EXPANDERS . . . SINCE 1892

Tube Expanders and Cutters for Condensers

No. 255—for average tube sheets

No. 270—for thick or multiple tube sheets



Series 400—IDEAL Tube Cutter (shown in use) for non-Ferrous Tubes. Available in sizes for ⅝" and larger Tubes.

#37

IDEAL

Confidence **is your assurance that IDEAL products will get your job done—and done *right*. The Gustav Wiedeke Company has specialized in Tube Expanders, Tube Cutters, and Operating Accessories since 1892. Write for *new* General Catalog 81.**

The Gustav WIEDEKE Company

Dayton 1, Ohio

IMPROVE YOUR DRAFTING

Now available in reprint form . . . the popular series of four articles from PETROLEUM PROCESSING, July-October, 1956, "How To Improve Your Drafting Production."

How to turn out better drawings faster, save time with proper tools and methods, improve mental efficiency, present design data clearly and effectively.

PLUS: "Make-it-yourself" Slide Chart for quickly dimensioning valves and fittings for nominal pipe sizes, 150 and 300 lb. series. The chart is printed on sturdy card stock and is easily assembled.

Order Reprint R31 . . . 24 pages plus Slide Chart . . . $1.25. Use the Reader Service Card, pp. 171-172, this issue, or send order to PETROLEUM PROCESSING —330 West 42 Street—New York 36, N. Y.

those who design mechanical power transmission setups. The products described are useful in connecting shafts of almost all types of prime movers and driven equipment. Contained within the book are many hints on proper selection of this type of equipment. Marland One-Way Clutch Co., 561 West Hillgrove Ave., La Grange, Ill.

Circle No. **36** *on Reply Card*

Stainless catalog

. . . lists complete line of corrosion-resistant metal products, such as pipe, valves, fittings, tubing and specialties: *Catalog 157* is a 104-page, hard-cover book that includes complete specifications and descriptions of all stainless steel products available from this manufacturer. Copies may be obtained by written request on company letterhead stationary to Power Stainless Products Co., Passaic, New Jersey.

Instrument terms

. . . and what they mean: *SAMA Tentative Standard, RC3-12-1955* is titled "Accuracy and Sensitivity Terminology as Applied to Industrial Instruments." These tentative standards of the Scientific Apparatus Makers Association define many terms used in describing and specifying industrial instruments. Copies may be obtained from Hapton M. Auld, Executive Secretary, Recorder-Controller Section, SAMA, 522 Fifth Ave., New York 36, N.Y.

Circle No. **38** *on Reply Card*

General purpose computer

. . . and its accessories are described in *Bulletin AB116*. The Bendix G-15 is a general purpose digital computer. With the addition of the DA-1 digital analyzer accessory, it combines the wide uses of a general purpose computer with simple programming for solving linear and nonlinear differential equations. Bendix Computer Division, Bendix Aviation Corporation, 5630 Arbor Vitae St., Los Angeles 45, Calif.

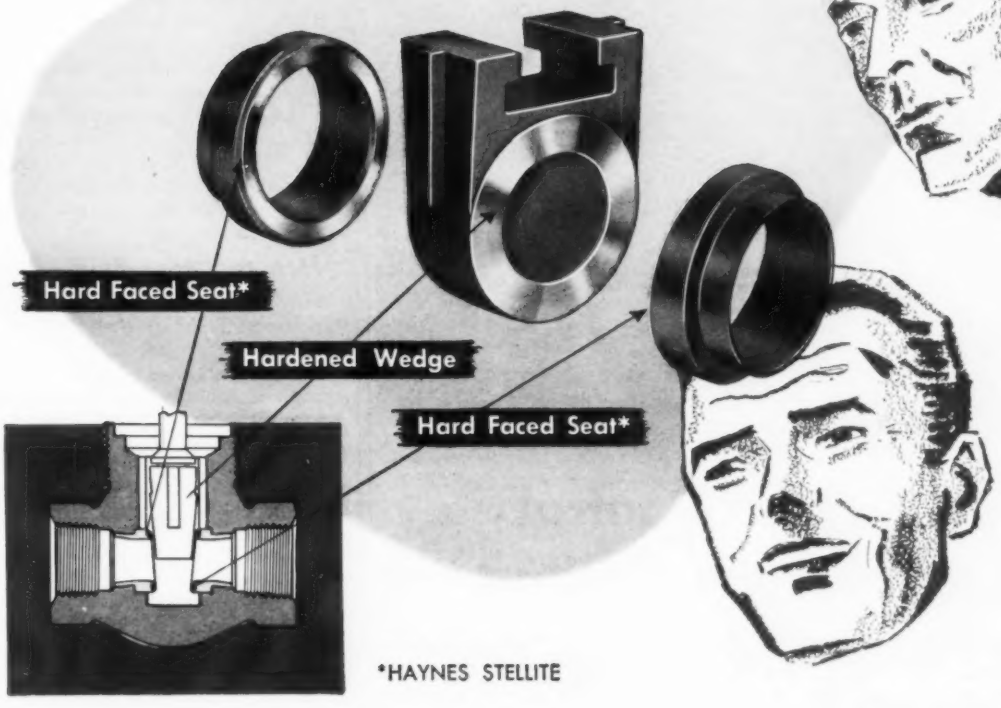
Circle No. **39** *on Reply Card*

Graphite coolers

. . . for cooling corrosives: *Bulletin No. 537* catalogs and describes, with pictures and diagrams, cascade coolers made of impervious graphite. Available in three standard lengths—9, 18, and 27 ft—and a range of tube sizes these coolers will handle almost all

Tough valve buyers appreciate this kind of...

Toughness



*HAYNES STELLITE

Here's why:—They know that to foil those troublesome valve "termites"—erosion, corrosion, and galling—requires built-in toughness which only seats faced with hard facing alloys AND hardened wedges can provide. Yes, it takes BOTH to do a real job and GP Valves provide both at no extra cost!

Vogt GP Valves feature the toughest and, since they are precision finished, the smoothest seating surfaces obtainable anywhere. That's why they are setting new standards of performance—longer, drop-tight service with minimum, low cost maintenance—in petroleum refineries, chemical plants, power plants and other industries. Available in a complete range of sizes from 1/4" to 2" and rated 800 pounds at 850° F. and 2000 pounds at 100° F.

Advt. No. 5 in a series describing the features of Vogt GP Valves.

Write For Your FREE COPY of Supplement No. 1 to Catalog F-9. Address Dept. 24A-FPP.

HENRY VOGT MACHINE CO.
P. O. Box 1918—Louisville 1, Ky.

SALES OFFICES: New York, Chicago, Cleveland, Dallas, Philadelphia, St. Louis, Charleston, W. Va., Cincinnati.

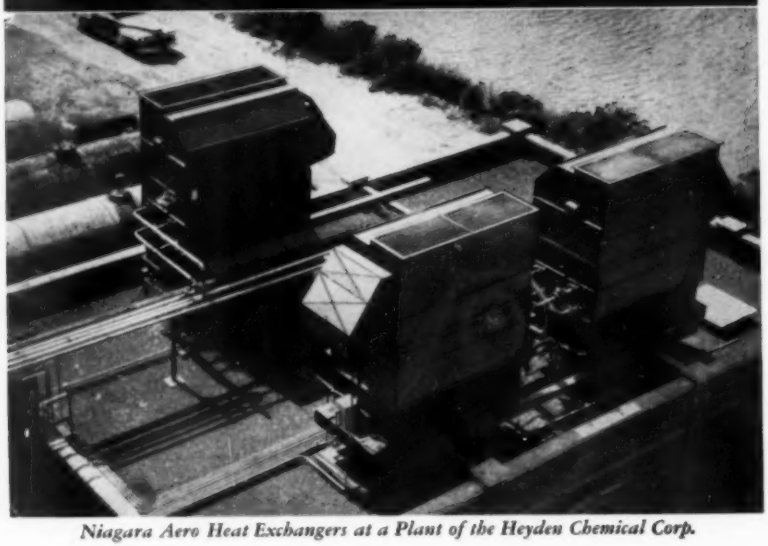
Vogt GENERAL PURPOSE GP Vogt FOR BETTER VALVES

DROP FORGED STEEL

VALVES

HAYNES STELLITE—Trade-mark of Union Carbide Corporation

IMPROVED CONDENSING and Cooling of Reflux



Niagara Aero Heat Exchangers at a Plant of the Heyden Chemical Corp.

Get Better Control of Distillation Product

● Liquid or vapor temperatures are always held constant by the Niagara "Balanced Wet Bulb" control method of evaporatively cooling or condensing, which automatically varies the cooling effect proportionately to the load. The distillation product is therefore uniform throughout all changes in climatic conditions the year around; it is the same in the heat of summer as in the freezing cold of winter. Continuous maximum production is thus insured.

Non-condensibles are effectively separated at the condensate outlet, with notable sub-cooling after separation for greater vacuum pump efficiency.

NIAGARA AERO HEAT EXCHANGERS give sustained full capacity in cooling and condensing with no dependence on cooling water . . . eliminating problems of water supply, availability, temperature, or quality.

For full information write for Bulletin 120

NIAGARA BLOWER COMPANY

Over 35 Years of Service in Industrial Air Engineering

Dept. PP-3, 405 Lexington Ave. New York 17, N. Y.

District Engineers in Principal Cities of U. S. and Canada

corrosives except a few strong oxidizing agents. Included in the bulletin is a guide for proper selection of Impervite cascade coolers. Falls Industries, Inc., Aurora Road, Solon, Ohio

Circle No. **40** *on Reply Card*

Elastomers

. . . from Du Pont: *Booklet A-2972* is a 15-page description of both neoprene synthetic rubber and Hypalon, a chlorinated polyethylene rubber. Each of the products has special properties that are described, and which make them suitable for special uses. Resistance to ozone, heat and weather are outstanding properties of the newer Hypalon. Elastomer Chemicals Dept., **E. I. du Pont de Nemours & Co.,** Wilmington 98, Del.

Circle No. **41** *on Reply Card*

Fire resistant fluid

. . . serves as a lubricant for air compressors: *Technical Bulletin No. 0-133* describes the synthetic lubricant, Pydraul AC, which is designed to prevent explosions or fires in air compressors and receivers. Lubricating properties are similar to those of SAE 30 oil, and Pydraul AC has the advantages of reducing cylinder deposits. Monsanto Chemical Co., 1700 S. Second St., St. Louis 4, Mo.

Circle No. **42** *on Reply Card*

Did You Miss These?

The following items, reviewed originally in October and November, have aroused considerable interest among readers. They are repeated here briefly for those who might have missed them the first time they appeared. For details or literature please use the regular Reply Card in this issue.

Fin-tube heat exchangers

. . . and their heat transfer characteristics are described in *Bulletin FH-3*. Included are a table of dimensions of longitudinal fin tubes, a type designation table, and charts for finside coefficients and finside pressure drops. Alco Products, Inc., Schenectady 5, N.Y.

Circle No. **43** *on Reply Card*

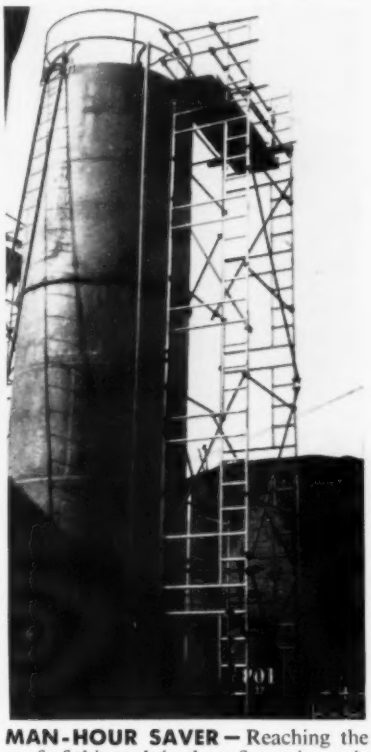
Butterfly valve manual

. . . is designed to help engineers select the proper type of this kind of valve: *Bulletin B-2* covers in 40 pages the many characteristics and physical

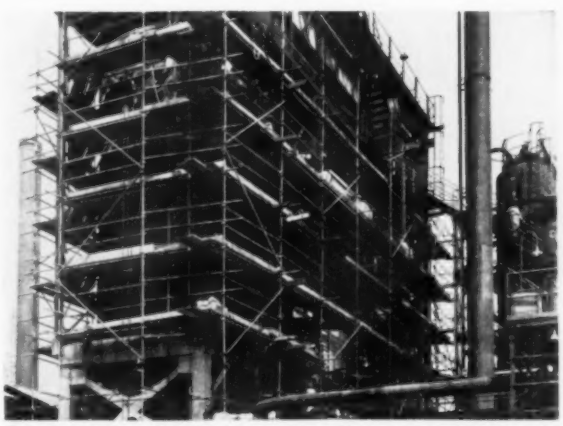
Advertisement

Scaffolding Methods . . . for Refinery Maintenance

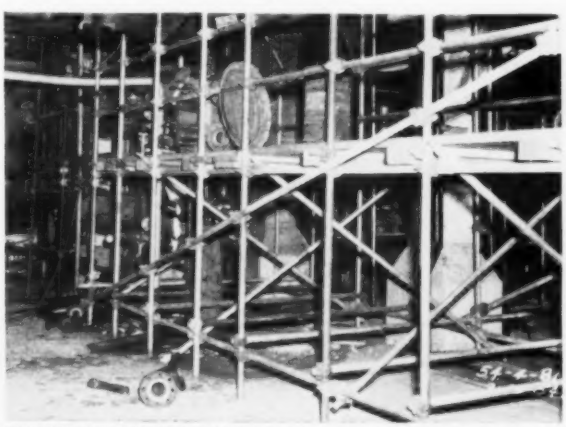
HIGH TOWER WORK—"TubeLox"® tube and coupler Scaffolding helps the maintenance crew get to the top of this tower alkylation unit of a large Midwestern refinery. Easily erected, strong, slender "TubeLox" Scaffolding is set up with only four components, offers minimum wind resistance for utmost safety. Getting on top, around, or inside any refinery unit, no matter how complex, is simple with "TubeLox" Scaffolding.



MAN-HOUR SAVER—Reaching the roof of this tank in the refinery is made possible by "TubeLox" Aluminum End Frame Scaffolding with built-in ladder. Light-weight, easy-to-handle frames save many man-hours of erection and dismantling time.



AT EVERY LEVEL—Versatile, all-purpose "TubeLox" Scaffolding provides safe working platforms at every level on the coke drum and pipe still section of the refinery. Only a minimum amount of wood staging is required. Workmen get up and around the building with speed and efficiency.



TURN AROUND TIME—Pulling a heat exchanger for cleaning at turn around time is no problem with the help of "TubeLox" Scaffolding. This practical, useful stationary or rolling scaffolding conforms to structures of odd shape or size easily for any maintenance, repair or inspection job.

To help you with your scaffolding methods, PS offers a complete nation-wide engineering service available to you locally. See the Yellow Pages in your 'phone directory for the nearest Patent Scaffolding office or representative that **sells** and **rents** "TubeLox" Scaffolds.

FOR GREATER SAFETY...EFFICIENCY...ECONOMY

THE PATENT SCAFFOLDING CO., Inc.

38-21 12th Street Dept. PP Long Island City 1, N. Y.
West Coast: 6931 Stanford Ave., Los Angeles 1, Calif.
In Canada: 355 Dufferin St., Toronto
Branches in all principal cities

differences of various butterfly valves. Also included are pressure drop and flow tables, conversion tables, theory and application information. The Henry Pratt Co., 2222 S. Halsted St., Chicago 8, Ill.

Circle No. **44** *on Reply Card*

Controlling combustion

. . . through automatic sensing and controlling instruments: *Control Fundamentals, Their Application to Combustion* is a publication reviewing the basic principles involved in automatic boiler control. Key components of combustion control systems are described, with full explanation of their interrelationship in operation of the complete system. Cleveland Fuel Equipment Co., Dept. A, 1111 Brookpark Road, Cleveland 9, Ohio.

Circle No. **45** *on Reply Card*

Thread gage

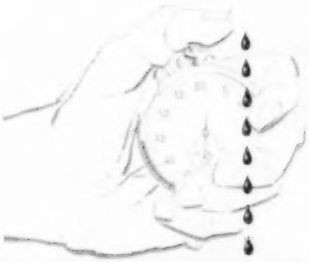
. . . identifies threads from 8 to 14 per inch, round or sharp, external or internal. This flat pocket gage is made from hard-surfaced laminated plastic and measures only 6¼-in. in length. In addition to the thread identification, the gage includes a color code identification of the manufacturer's line of Anvil Brand fittings. The gage is available free to those who write to Pittsburgh Pipe & Coupling Co., Allison Park, Pa.

Circle No. **46** *on Reply Card*

Aluminum handbook

. . . is a comprehensive reference book on the uses and specification of this material. *Alcoa Aluminum Handbook* presents concise data on aluminum alloys and mill products in an easy-to-read tabular form. The 176-page, hard cover handbook presents information on alloy standards as well as the properties, sizes, and tolerances

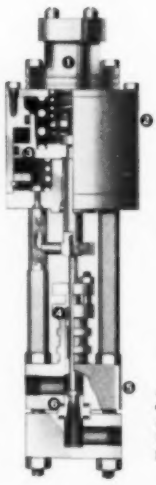
Please turn page

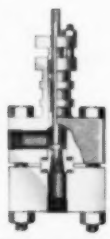


Split second action ...small flow control ...at 6,000 psi

New achievement by Annin in high pressure control and precise valve response for Research—Development—Process applications

Annin's new Model 9460, designed for working pressures to 6,000 psi, provides research, pilot plant and process control engineers with an extremely responsive small flow control valve suitable for low capacity systems. The operator will fully stroke in either direction in 0.75 seconds or less. New design features include: ❶ integral positioner, open-on-air-failure or close-on-air-failure action; ❷ Annin's 600 Series Domotor operator; ❸ differential area piston, eliminating need for loading regulator; ❹ universal stuffing box for —400°F to 750°F; ❺ offset globe or angle body design; ❻ valve plug stem and seat ring common to both globe and angle bodies. For reliable fluid control and flexibility of application Annin offers the **best source** for solving any small flow control problem.





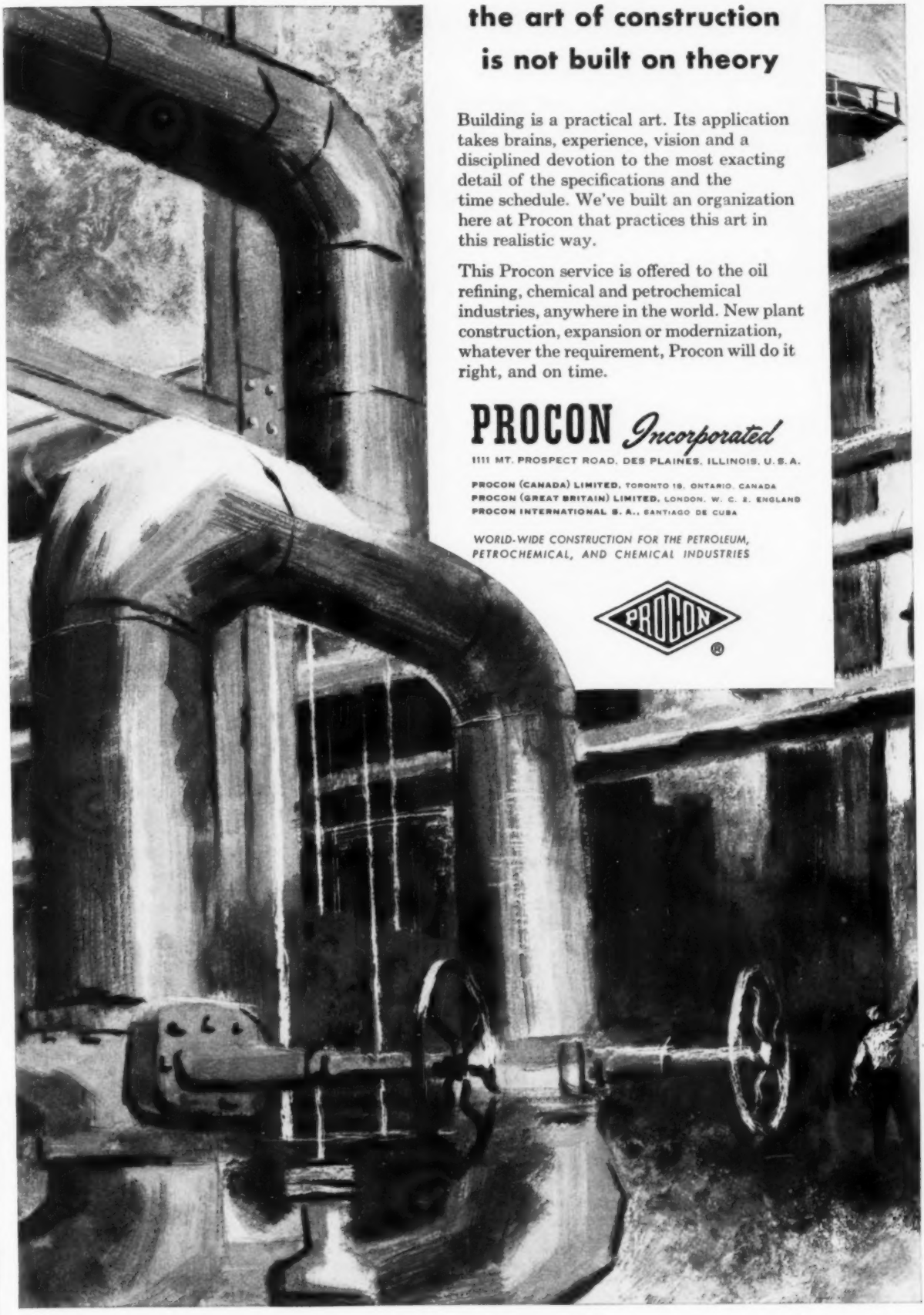
Model 9461
angle body

Angle bodies are available with body sections rotatable in 90° increments for piping convenience.

YOURS FOR THE ASKING—Complete information and specifications are contained in Bulletin No. 9400. Write for your copy today.

THE ANNIN COMPANY
DIVISION OF THE ANNIN CORPORATION
6570 Telegraph Road, Los Angeles 22, Calif.

ANNIN *Control* **VALVES**



the art of construction is not built on theory

Building is a practical art. Its application takes brains, experience, vision and a disciplined devotion to the most exacting detail of the specifications and the time schedule. We've built an organization here at Procon that practices this art in this realistic way.

This Procon service is offered to the oil refining, chemical and petrochemical industries, anywhere in the world. New plant construction, expansion or modernization, whatever the requirement, Procon will do it right, and on time.

PROCON *Incorporated*

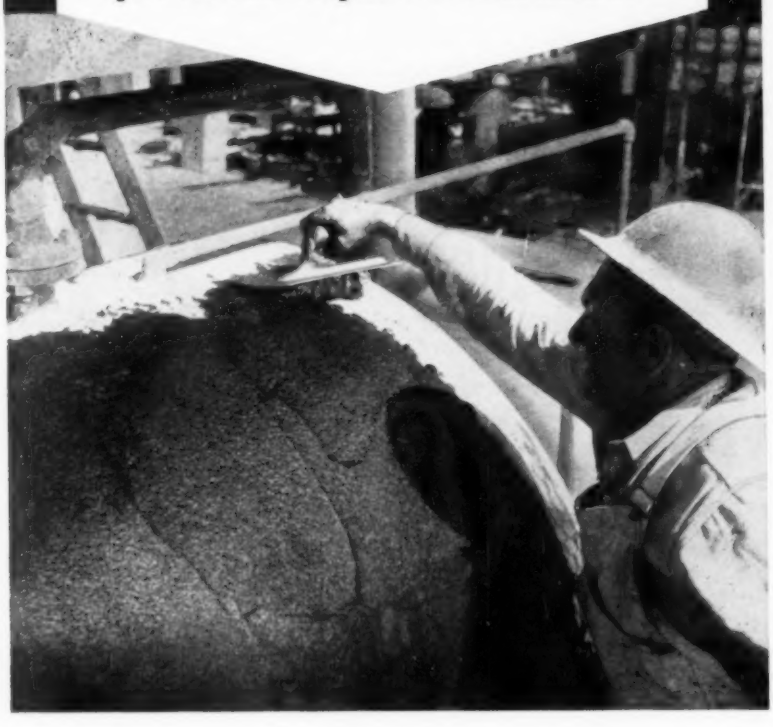
1111 MT. PROSPECT ROAD, DES PLAINES, ILLINOIS, U.S.A.

PROCON (CANADA) LIMITED, TORONTO 19, ONTARIO, CANADA
PROCON (GREAT BRITAIN) LIMITED, LONDON, W. C. 2, ENGLAND
PROCON INTERNATIONAL S. A., SANTIAGO DE CUBA

WORLD-WIDE CONSTRUCTION FOR THE PETROLEUM, PETROCHEMICAL, AND CHEMICAL INDUSTRIES

PROCON ®

Laykold® WEATHERCOAT
protects exposed insulation



INSULATION on towers, tanks and exchangers must be kept DRY. If moisture gets through, the efficiency drops.

Modern refinery and plant design places many major insulated vessels "in the open." You can maintain the efficiency of your insulation with easy-to-apply Laykold Weathercoat.

Weathercoat is a fibrated asphalt-base material of easy troweling consistency that dries to a black, remarkably tough and tenacious coating. A majority of the leading refineries are regular users of Weathercoat.

A new product: Mastic Weathercoat, a bodied material, for use wherever economy demands the application of a *single*, thick layer.

Write today for our free illustrated brochure, entitled "Laykold Weathercoat for Insulation Protection."

American Bitumuls & Asphalt Company

200 Bush Street, San Francisco 20, California

Baltimore 3, Md. · Mobile, Ala. · Inglewood, Calif. · St. Louis 17, Mo. · San Juan 23, P.R. · Oakland 1, Calif. · Perth Amboy, N.J. · Cincinnati 38, Ohio · Tucson, Ariz. · Portland 7, Ore.

LEADING MARKETERS OF ASPHALTS, CUTBACKS AND BITUMULS – NATIONWIDE

of mill products produced from them. Aluminum Company of America, 781 Alcoa Building, Pittsburgh 19, Pa.

Circle No. **47** *on Reply Card*

Compressor troubles

. . . and their diagnoses: the subject of *Bulletin PC-509P* with cartoon sequences of common air-cooled and water-cooled compressor troubles. Common symptoms of each difficulty are listed under a trouble heading such as insufficient pressure, compressor knocking, overloaded motor, or eight other common operating difficulties. Worthington Corp., Merchandising Sales Dept., Harrison, N.J.

Circle No. **48** *on Reply Card*

Slide calculator

. . . provides quick answers to questions of cost and quantity conversions for chemical additives. Aimed primarily at the petroleum industry, the calculator provides answers in *gal/bbl* as well as *ppm*.

Specific quantities calculated on the slide calculator include: gal/bbl, ppm, lb/bbl, cost/lb, cents/bbl, and mils/bbl. Additional conversion scales relate API gravity and lb/gal, and °C to °F. The calculator may be obtained by writing Armour and Company, Chemical Division, 1355 W. 31st St., Chicago 9, Ill.

Circle No. **49** *on Reply Card*

Ultrasonic instrument

. . . measures thicknesses from one side only. The SO-100 Sonizon is a portable thickness tester weighing only 30 lb, and simple to operate. Thickness is indicated by a "pip" on a TV tube mounted on the face of the instrument.

A single crystal probe is touched to the material to be tested. Inaudable sound waves emitted from the crystal are varied until they hit the resonant frequency of the material, which depends upon its thickness. This resonant frequency is translated into a thickness "pip." Calibration is in thousandths of an inch for the type of material tested, and maximum thicknesses range to 4 inches.

This instrument makes it possible to detect thin spots in cast, formed, welded or ground objects; eccentricity in cast iron pipes, or to compare unknown thicknesses of vessels with known thicknesses. Magnaflux Corporation, 7300 W. Lawrence Ave., Chicago 31, Ill.

Circle No. **50** *on Reply Card*

MR. ALEX PANCRAZI (left), Pisa Univ. (Italy) graduate, Chief Chemist, Eastern Wine Corp., Bronx, N.Y. (Right), Michael De Piano, N.Y. representative, Cooper Alloy Corp.

PANCRAZI OF CHATEAU MARTIN (Eastern Wine Corp.) tells why he specifies "Cooper Alloy Only" on stainless steel valves and fittings

Q. Mr. Pancrazi, why have you changed to stainless steel valves and fittings at Chateau Martin?

A. To assure product purity. Other metals can cause minute contamination reducing clarity and brightness; stainless steel does not.

Q. What valve model do you find most suitable?

A. After extensive testing, we picked a renewable-disc inside-screw globe valve—Cooper Alloy only.

Q. Why "Cooper Alloy only"?

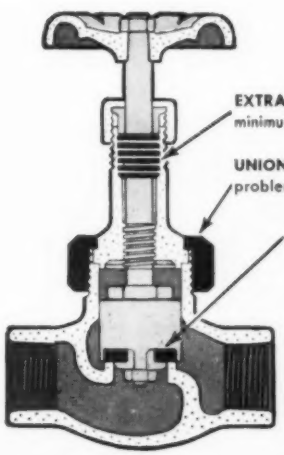
A. Because of three features I find combined nowhere else: renewable retained disc; union-bonnet construction; and extra-deep square-compression stuffing box.

Q. Why is each of these features important?

A. Soft disc gives better seal; retention in metal jacket prolongs its life. When disc replacement is needed, union-type bonnet eliminates difficulties normally found in screwed-in bonnets, removes another threaded joint from product contact. Extra-deep stuffing box with unique square compression reduces maintenance, gives tighter seal at stem.

Q. Don't any competitive valves possess these features?

A. Not one has them all. That's why, to maintain our product contamination-free and to reduce maintenance costs, we insist on "Cooper Alloy only."


EXTRA-DEEP STUFFING BOX holds minimum 6 turns Blue African asbestos
UNION BONNET JOINT eliminates problems found in screwed-in bonnets
RETAINED RENEWABLE DISC for tight seal and long life

COOPER ALLOY Figure 15RD Globe Valve, inside screw rising stem, 200-lb. service, screwed ends, renewable retained disc of composition you specify.

YEARS AHEAD IN DESIGN SUPERIORITY! No matter what your valve type—globes, gates, angles, checks, or Y's—the Cooper Alloy model's outstanding design features will be important to you. Cooper Alloy, with 35 years of pioneering experience in stainless steel, does not merely adapt existing brass and iron valve patterns; it creates valves *designed to be cast in stainless!* **Check the special design features of valve shown at left.**

As the little CA man below is saying: *"You Can Tell A Cooper Alloy Valve As Far As You Can See It!"* Write today for *your* copy of our folder "Design Factors In Stainless Steel Valves." The Cooper Alloy distributor near you will be glad to show you the complete line of Cooper Alloy valves *and fittings*, and their advantages. He can serve you promptly from local stocks.

COOPER ALLOY

Corporation • Hillside, New Jersey

VALVE & FITTING DIVISION

THIRTY-FIVE YEARS OF STAINLESS STEEL PIONEERING

 (To obtain more data on advertised products see page 170)

A bird in the hand . . .

Solving the Technical Manpower Shortage—No. 1 in a series

IF YOU'VE been scratching your head trying to figure out how to find the technical men you need, or if you've been doing a man-and-a-half's work because your group is understaffed—don't look for much relief in the near future.

The technical manpower situation has been bad—and all indications are that it will get worse. According to one source, the average experience of most industrial concerns last year was that they were able to hire only 50 to 55% of their needs for young engineers and scientists. That's a drop of nearly 10% from the year before—a serious discrepancy between supply and demand.

Can we wait until 1969?

As for the future—it's not bright. The number of youngsters of college age today is the smallest it has been for some time, because of the low birthrate of the mid-30's. We were studying the birthrate figures recently. The low point (dated from 1915, the oldest figures we checked) was 16.6 births per 1000 population in 1933. For the next six years, until 1939, the birth rate moved lazily up and down between 16.6 and 17.6. That's when those youngsters were born who will be graduated between now and 1961. The birth rate didn't really begin to rise until 1941 (18.9), and reached a post-war peak in 1947 (25.8).

By 1963, then, the situation might be expected to begin to improve—and by 1969 it should be practically solved. But both 1963 and 1969 are a long way off, and there's work to be done now. How can we solve the shortage today?

Cut turnover for a start

One of the first places to focus attention is on the losses we are suffering of technical people from our own organizations. Dr. Howard A. Meyerhoff, Director of the Scientific Manpower Commission, made this suggestion at the recent annual meeting of the American Petroleum Institute.

According to Dr. Meyerhoff, the average turnover in technical personnel is about 16%. That means that the new man you hire today will stay with you, on the average, only a little more than six years.

"How," you ask, "will reducing that turnover improve the technical manpower supply? It won't 'make' more engineers and scientists. We'll still have the same number of people."

It can help in two ways

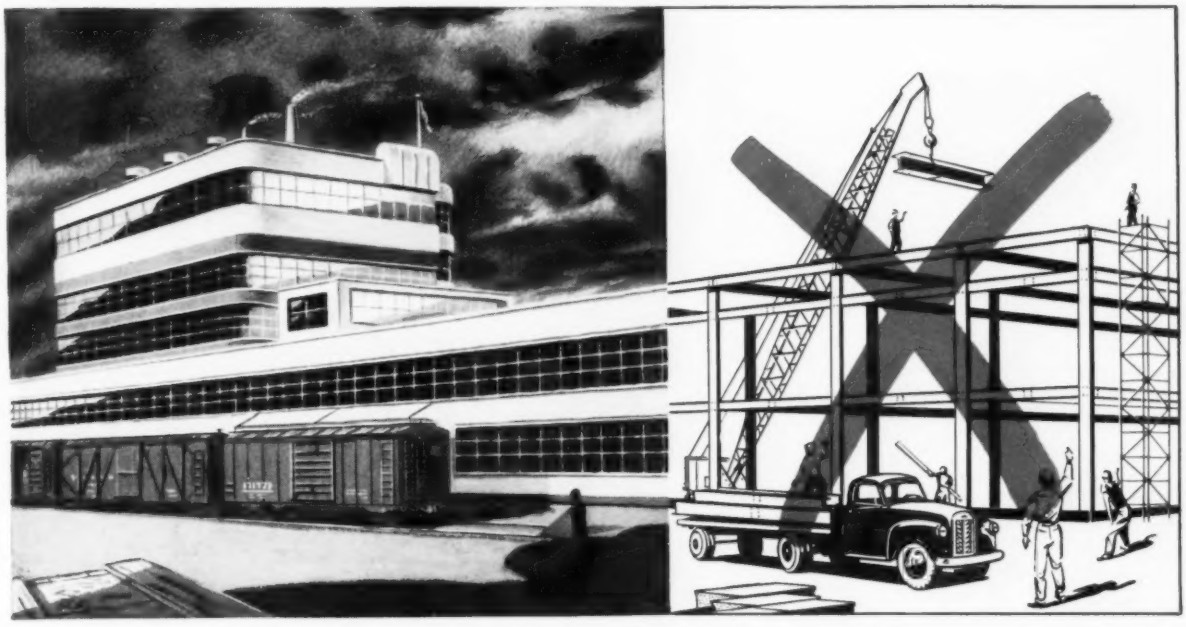
1—If graduate engineers and scientists leave your company to go into some other field where their professional training is not utilized—such as sales—then everyone loses technical manpower. You may not add to the supply by keeping a man, but you deplete it if you permit him to leave the field.

2—Whenever a new man joins your company, there's an initial period of low productivity. In fact, it could be a period of negative productivity—if one of your seasoned technical men has to spend any great amount of time training the newcomer. Even a man with experience doesn't become fully productive until he is familiar with your way of doing things. The fewer technical men you lose, the fewer replacements you'll have to hire—and your over-all technical efficiency will be increased.

We know of no figures to prove this point, but we wouldn't be surprised to learn that for every two new men you hire, you get during the first year the effective services of only one man. On that basis, if the petroleum processing industry employs 60,000 technical men and has a 16% turnover each year—then close to 10,000 replacements are hired annually. If that figure were to be cut in half, it would mean a net increase in the supply of effective technical manpower of 2,500 men.

How to reduce turnover is another subject, which we'll go into next month. Right now, we want to stress its importance and potential benefits. Study your own figures, and see if they don't prove that "a bird in the hand is worth two in the bush."

memo to chemical management . . .



How to Expand Production

without additional capital investment!

Consider these typical examples:

1. You plan to step up production of one of your present products. The manufacture involves intermediates. Your plant site is limited. *There may be no need to buy additional land or move your plant!* Here's what a number of Baker & Adamson customers have done. They have *abandoned* production of intermediates and purchased them instead from B&A. The space formerly devoted to intermediates is now used more profitably and efficiently for expanded production of their end product.

2. You plan to produce a *new* product. One or more "special" chemicals form part of the manufacturing process. In most cases, you will save time and money by buying these chemicals from B&A rather than making them yourself. Baker & Adamson is fully equipped to supply "custom-made" chemicals for such needs.

If either of these examples represents a situation you will soon have to resolve, we will be glad to explain in detail why you should call on Baker & Adamson. Here, briefly, are a few of many excellent reasons:

✓ As the country's leading producer of extremely high purity laboratory reagents and fine chemicals, B&A can be depended on to meet your every requirement for fine and special chemicals in either L/C/L or tonnage quantities.

✓ B&A's versatile, adaptable facilities now produce several hundred products . . . are well equipped to supply "custom-made" chemicals for virtually every need.

✓ B&A's 27 sales offices and coast-to-coast chain of warehouses assure you of dependable, local service.

We invite your inquiries.

BAKER & ADAMSON®
Fine Chemicals
GENERAL CHEMICAL DIVISION
ALLIED CHEMICAL & DYE CORPORATION
40 Rector Street, New York 6, N. Y.

Offices: Albany* • Atlanta • Baltimore* • Birmingham* • Boston* • Bridgeport* • Buffalo* • Charlotte* • Chicago* • Cleveland* • Denver* • Detroit* • Houston* Jacksonville • Kalamazoo • Los Angeles* • Milwaukee • Minneapolis • New York* • Philadelphia* • Pittsburgh* • Providence* • St. Louis* • San Francisco* Seattle • Kennewick* and Yakima (Wash.) In Canada: The Nichols Chemical Company, Limited • Montreal* • Toronto* • Vancouver* *Complete stocks carried here.

IN OIL REFINING...
More Processing Vessels
Come From Wyatt's
Shops than From any
other Fabricator!
If Plastics can Serve Check With
Wyatt's PLASTICS, INC.
MOLDERS - FABRICATORS - DISTRIBUTORS
Subsidiary, Wyatt Metal & Boiler Works
Wyatt's
HOUSTON-DALLAS-NEW YORK-TULSA
MANUFACTURERS AND ERECTORS SINCE 1913